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OCTOBER 1996

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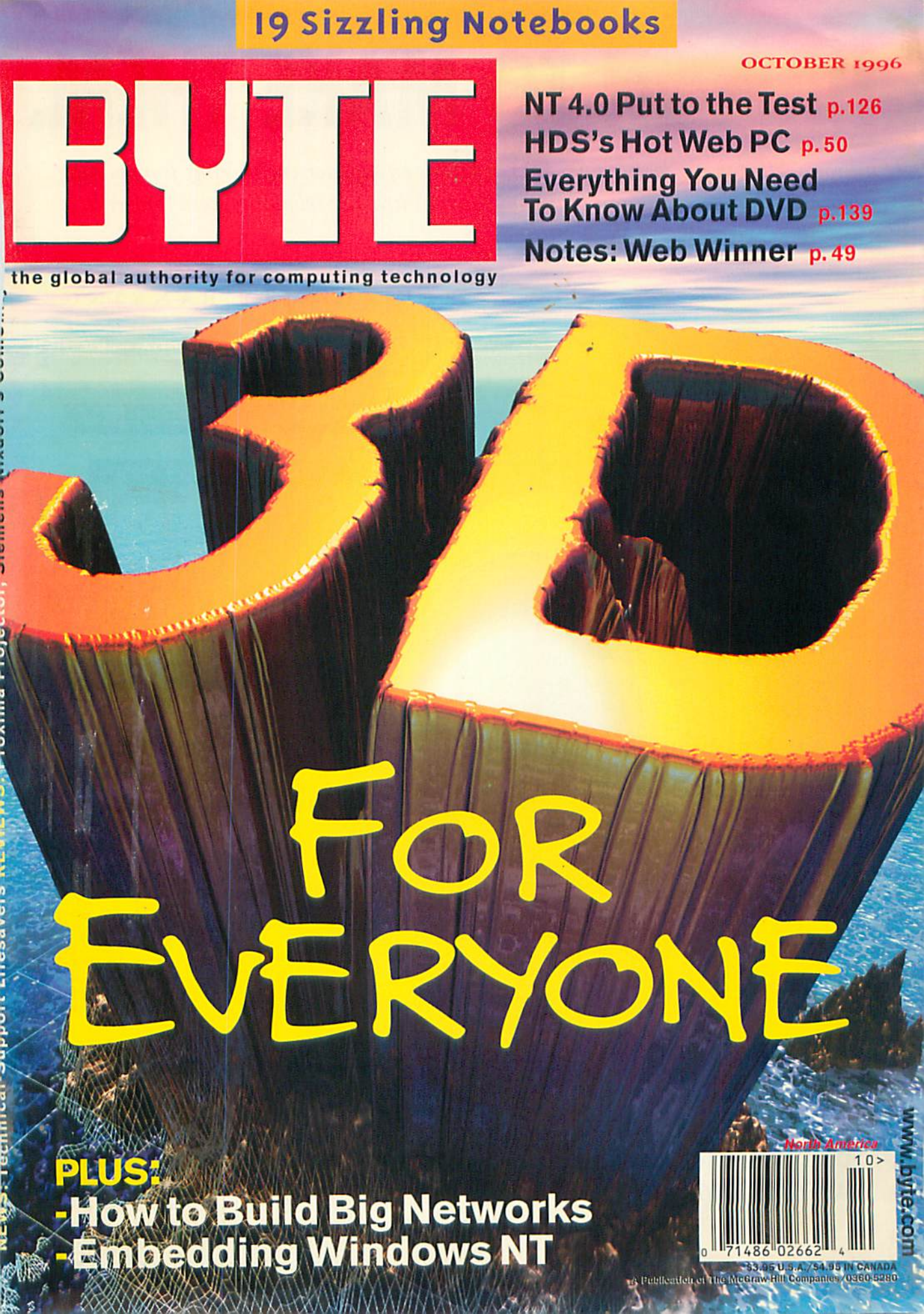

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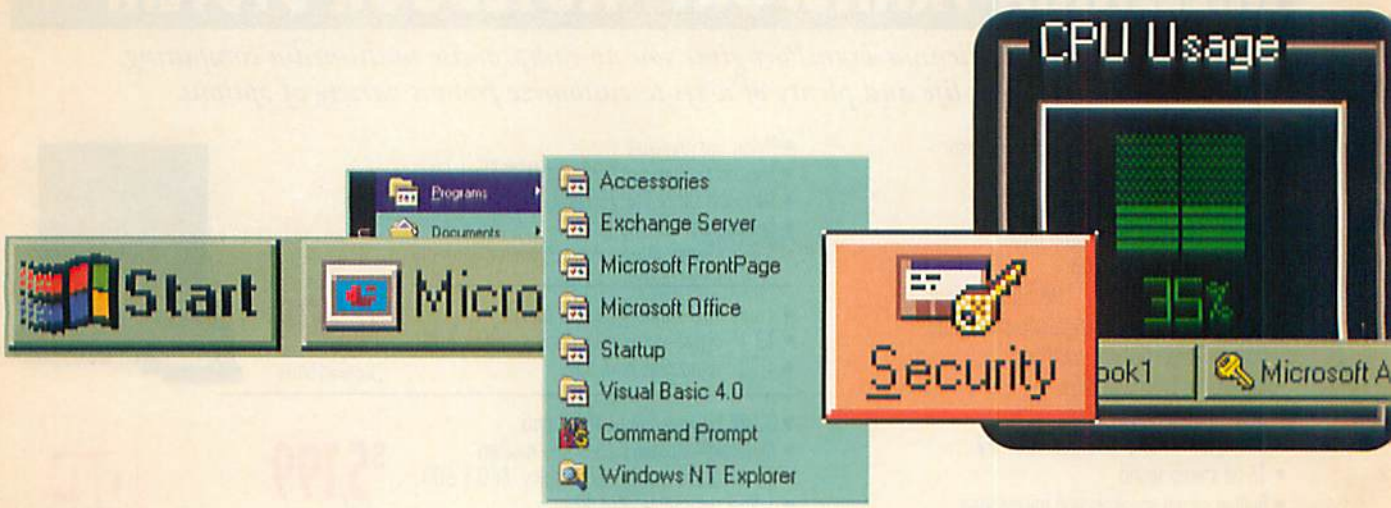

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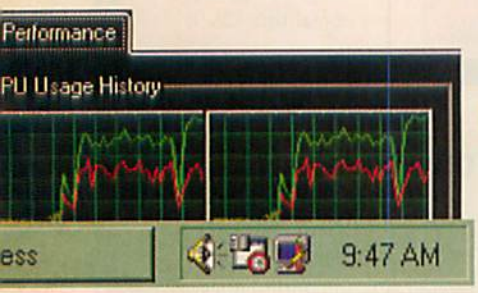

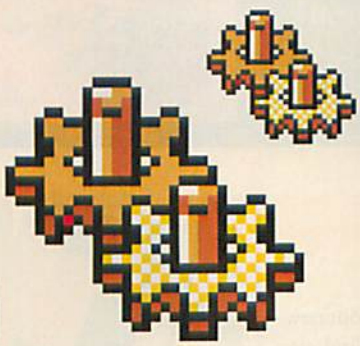

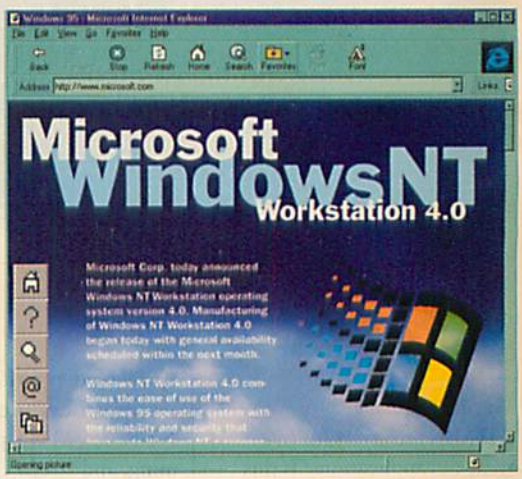

The new Windows NT® Workstation 4.0 operating system has been designed to be the most powerful desktop operating system. And because all that power is controlled by the Windows® 95 interface, it's much easier to use. The total 32-bit power of Windows NT Workstation means reliability, security, and easy access to the Internet and intranet. It's reliable because all applications run in their own memory space—so that new game beta won't crash last week's work. It's secure because integrated features let you lock your system all the way down to the file level, so you can count on applications and data being safe.

It's Internet-ready because it's loaded with built-in features like TCP/IP, the Microsoft Internet Explorer browser, and integrated Peer Web Services, which lets you create a small intranet for your workgroup. And because it's all controlled by the Windows 95 interface, you can customize your system to work and look however you like. So does all this mean Windows 95 is history? Absolutely not. Windows 95 may still be your best choice, depending on your existing hardware and applications. We suggest you dive headfirst into our Web site to compare and contrast operating systems to see which 32-bit desktop is best for you.

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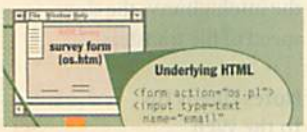

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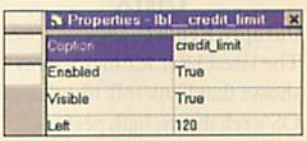

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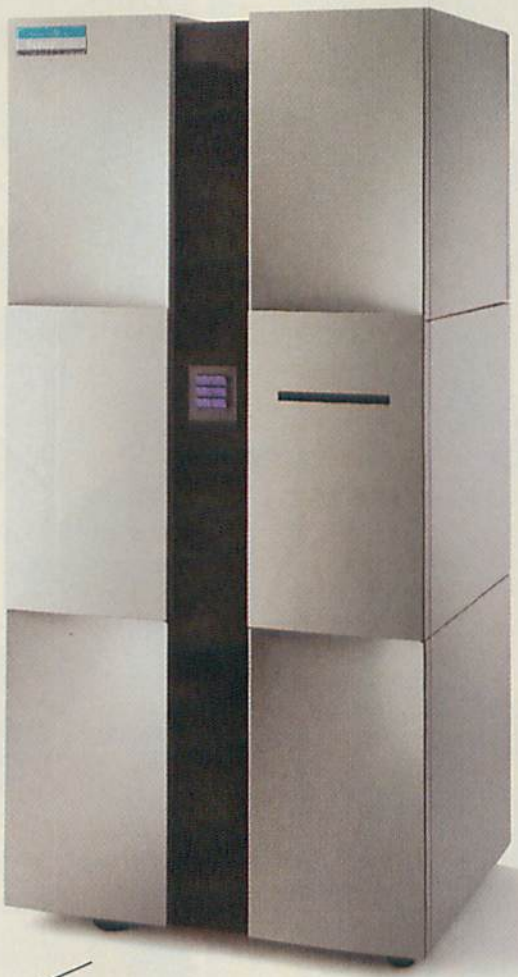

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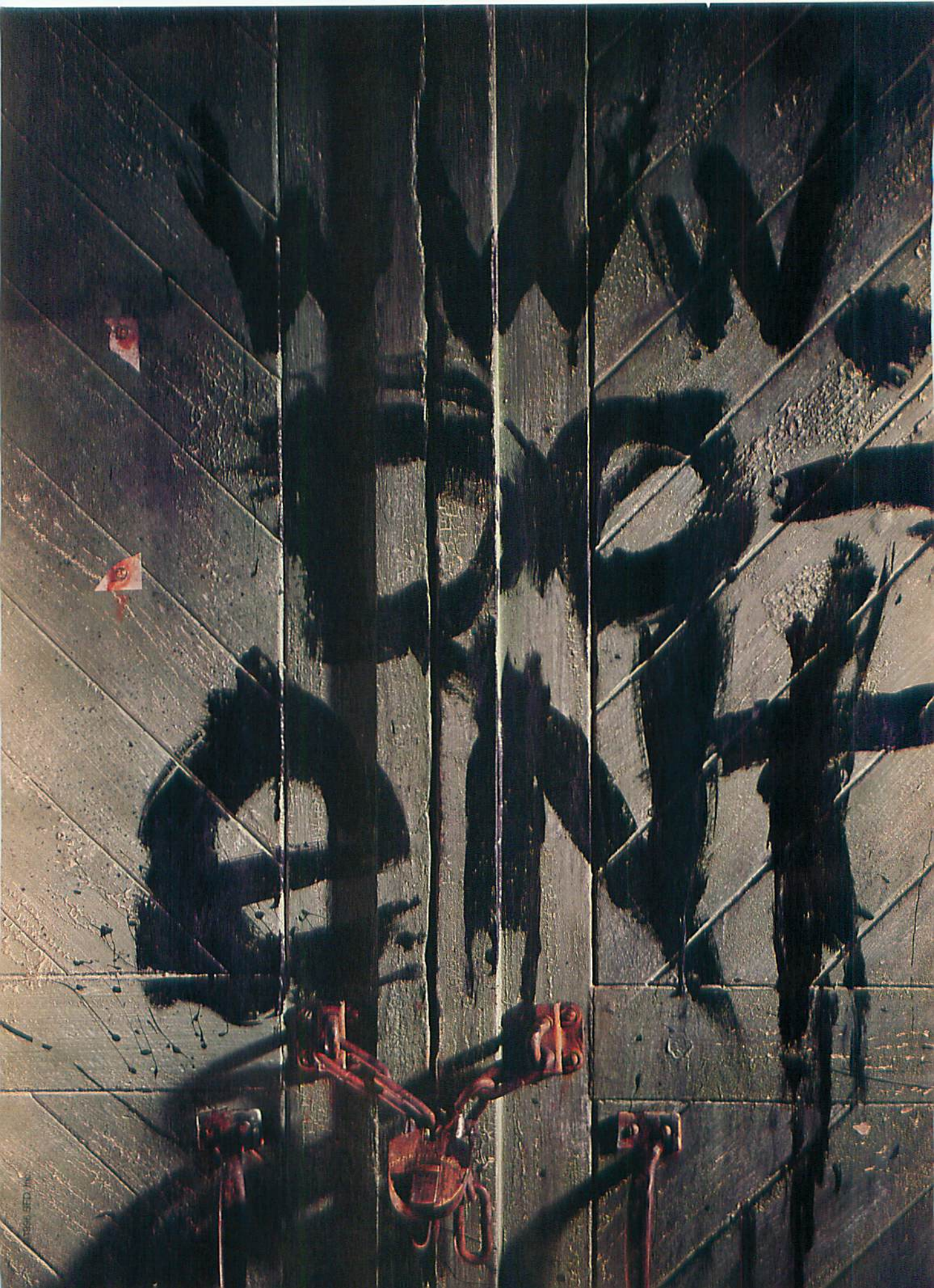

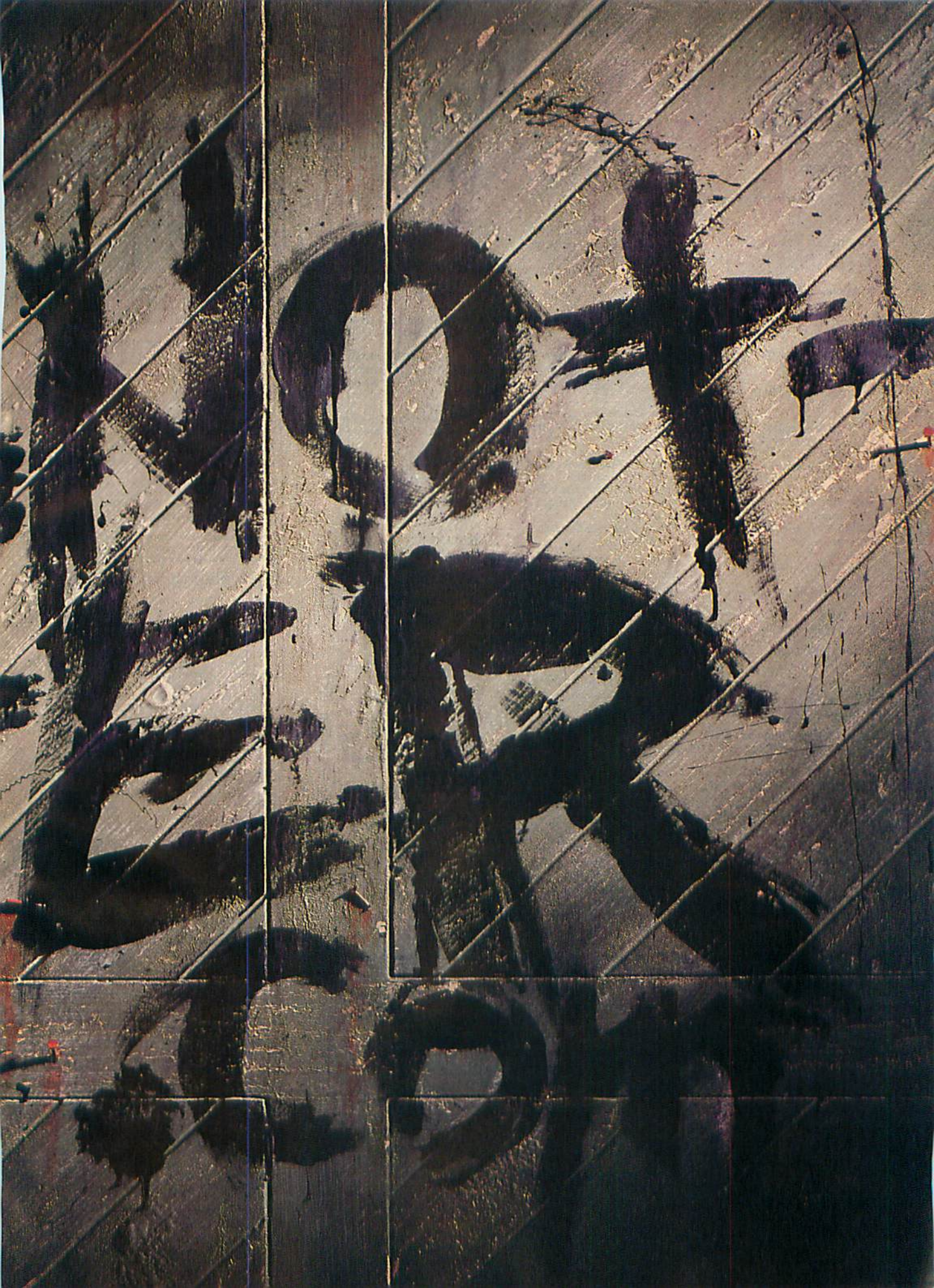

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Wanted: New Software

Today's shrink-wrapped applications are the last place you'll find innovation.

The search for the killer desktop app is dead, judging from the dearth of anything really interesting outside of the graphic arts/multimedia and geographic-information markets. Amidst a golden era of OSes, server software, Web stuff, and development tools, the best you can say about most desktop apps is that they are easier to install now that they come on CD-ROMs instead of floppies.

Too harsh? What was the last new client application authored by Microsoft? I come up with Access, in 1992, and even it wasn't totally homegrown in Redmond. This year's FrontPage was acquired in full, although it has since been seriously reworked. Lotus's now-defunct Improv came out for Next in 1990 and for Windows in 1993. Apart from these few, all we've seen are continuing improvements (albeit not unappreciated ones) to existing suites, accompanied by feature bloat.

"Who cares?," ask the Webmeisters. "With Hypertext Markup Language [HTML], Java, a browser, and plug-ins, shrink-wrapped software is a dinosaur."

The Web is a powerful tool, and it really has changed everything. The ferment in Web tools and server applications will obviously produce profound innovations—probably even one of those legendary paradigm shifts.

But I'm not buying into the idea that server apps will completely replace desktop apps in this decade. The bandwidth and network reliability are just not there. And ultimately, whether software vendors write applications in giant hunks of C++ code and deliver them on CD-ROMs—or write them in small pieces of Java code and wire them to us—apps will still need to be more innovative.

Nor will custom development replace packaged software, even if the most optimistic scenarios about programmer productivity and code reuse come true. No company has the time or money to be its own sole source of software.

The greatest innovation in computing since the invention of the microprocessor has been shrink-wrapped software. The ability of computer professionals to deliver fast, inexpensive solutions will, for the foreseeable future, depend on the weaving together of custom and shrink-wrapped server and client applications.

My hope is that the industry will do something more than just add HTML converters to five-year-old apps. For example, seven years after Hewlett-Packard unveiled its ultimately unsuccessful NewWave shell for Windows, I'm still waiting for easy-to-use but powerful agents.

Want thankful users? Give them software that automates the repetitive yet complex tasks that consume most workdays. I would love something that I could "program" to gather memos, spreadsheets, e-mail, and whatever else I need to assemble monthly reports.

The greatest innovation in computing since the invention of the microprocessor has been shrink-wrapped software.

My impression that the software industry has entered a slacker phase was reinforced by a recent trip to Xerox's fabled Palo Alto Research Center. At PARC, you can see real innovation in areas as conceptually simple and practically difficult as viewing large amounts of data (an entire company organization chart, for example) quickly and easily. The kinds of inexpensive graphics hardware discussed in this month's cover story open up even more possibilities in this arena.

Maybe it's hard for concepts like data visualization and cross-application agents to clear the hurdles that large software companies put in front of new product development. I imagine that any product manager with fire in the belly still has to answer to company bean counters who ask, "Is there a $100 million market for the product this year?" I sure hope that someone out there is looking beyond today's installed base.

When I go to Comdex next month, I'll be looking for interesting and practical new desktop applications to present our Best of Comdex awards to. (Vendors: See http://www.byte.com/vpr/vpr.htm for details.) Tell me what you need from shrink-wrapped software in our forum at http://www.byte.com. I'll carry the message back to the software industry.

Mark Schlack

Mark Schlack, Editor in Chief
mschlack@bix.com

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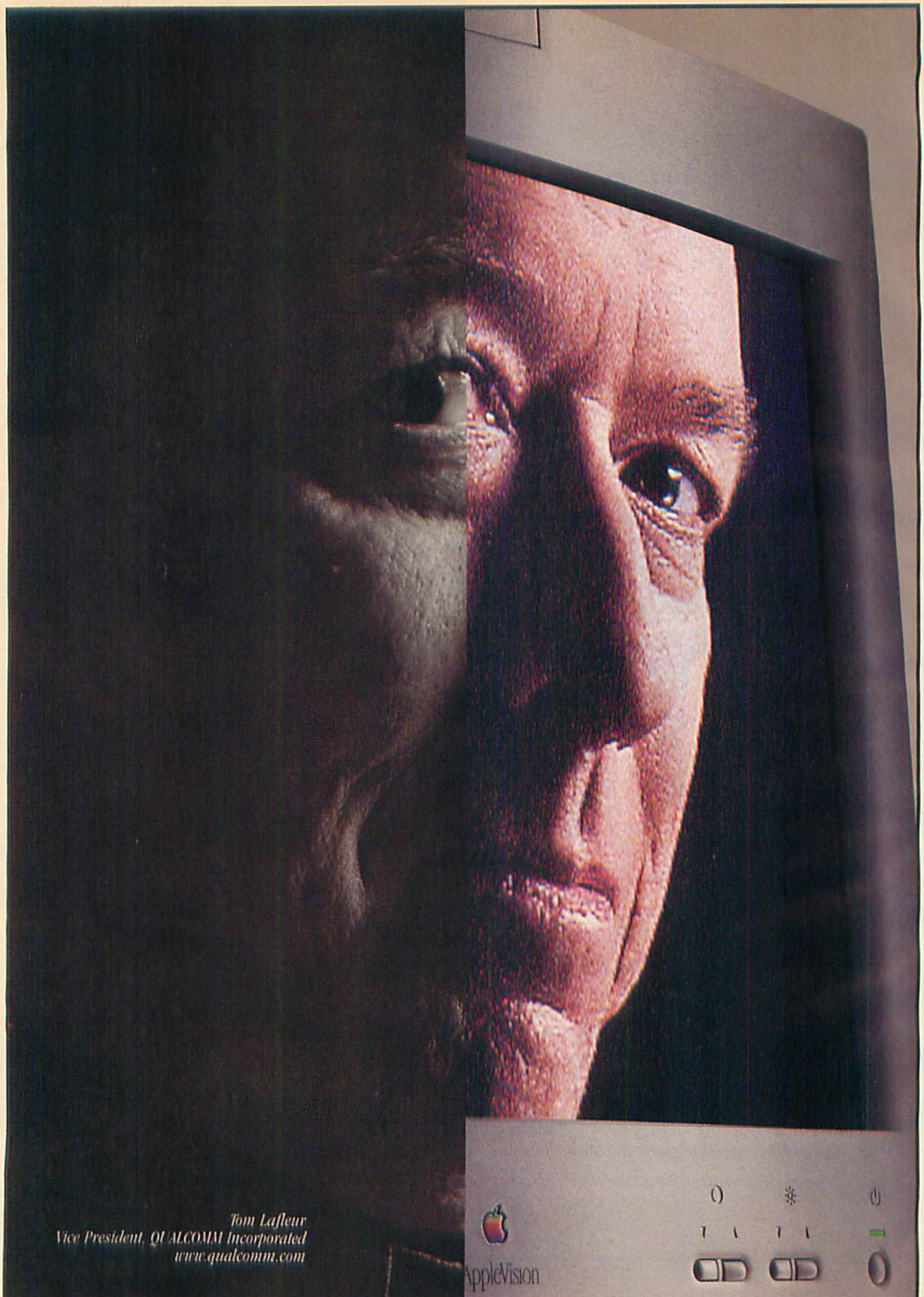

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inbox

You're Welcome!

Tom Thompson's "The Network in the Server" (July) is the most lucid and helpful explanation of Tandem's ServerNet system area network and its potential applications that I have seen. That includes our own internal publications. Thank you.

Matt Riesz
Senior advisory systems analyst
Tandem Computers

I just read "The Network in the Server" and am impressed by the clarity with which you explained the NUMA-Q architecture. Congratulations.

Kevin Joyce
Marketing manager, NUMA-Q
Sequent Computer Systems

NT Trade-offs

I enjoyed the excellent article about Windows NT, "4.0 Isn't for Everyone," by David Linthicum in the July issue. I was puzzled, however, by the absence of a fairly obvious conclusion: The considerable performance penalty imposed by the new shell and the questionable architectural changes made to accommodate it may make sense on a workstation, but they are of dubious worth on a server. With 4.0, the design center of NT seems to have shifted decisively toward the client. That's fine for me; I'm interested in NT primarily as a workstation OS—interest motivated primarily by stability. But my guess is that Microsoft will have a hard time converting server owners, whether from NT 3.51 or from other OSes.

Will Kling
Milford, NH

"4.0 Isn't for Everyone" was informative, but you make too much commotion about the kernel-mode issue. Although moving the graphical device interface (GDI) into the NT Executive gives it the potential to crash the OS, this does not seem likely. The current GDI/Window Manager subsystem is highly stable and rarely faults. The move to kernel mode only simplifies its design, making it easier to debug. Since version 3.1, all of NT's other low-level device drivers (disk device drivers, SCSI controller drivers, etc.) have operated within the Executive with a high degree of reliability. There is no reason to suggest that the graphics subsystem need be any different. If, in NT 3.51, CSRSS.EXE faults for any reason, the whole OS shuts down, as it is considered a critical process. What is the practical difference if the graphics subsystem crashes and the OS subsequently shuts down, or if the graphics subsystem crashes and takes the OS with it?

Rene Gollent
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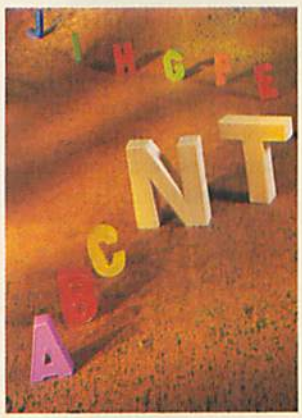
The GDI issue involves the potential for OS failure due to reengineering of NT. The claim that the NT 3.5 kernel is inherently stable does not



automatically carry forward to the next instance of the OS, considering the changes that Microsoft has made. At the beta stage (Build 1234), it was unclear how moving GDI to Ring 0 might affect stability in the final release—we were not able to crash the beta system. However, as with other operating systems that exploit Ring 0, the trade-off is stability for performance. Microsoft is selling NT as an OS that is more stable than Windows 95 and as an OS reborn for the client. The changes made to NT to sell it as a high-performance client could jeopardize its traditional use as a server OS. That's why I made an issue of it. As I write, Windows NT 4.0 is just leaving beta. We'll know who's right about the GDI issue very soon.
—David Linthicum

"NT and the Net" (July) provides a good overview of Microsoft's strategies surrounding its Internet Information Server (IIS). The discussion of the benefits of the Internet Server API (ISAPI), however, failed to give credit where credit is due. The interface now known as ISAPI was first developed as a proprietary interface by Process Software (http://www.process.com) for its Purveyor Web server for Windows NT. Late last year Microsoft and Process announced their collaboration on an open standard—ISAPI—based on the Purveyor API. To both companies' credit, DLLs written to the original API still function under ISAPI using both Purveyor and IIS.

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Amadeus Consulting Group
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You Can Teach an Old Chip

Kudos (again) to Tom Halfhill for his detailed yet

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clear explanation of how the MMX instructions work with Intel-type CPUs ("x86 Enters the Multimedia Era," July). The article's nuts-and-bolts focus typifies why BYTE is a valuable resource for all of us.

Tony Dahlman
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Another Lesson Learned

As your July Web Project column was about "Lessons Learned," I am prompted to suggest this lesson: In cases where a quoted URL refers to a directory, or to the "top" of a site, almost everyone these days (including BYTE) seems to omit the trailing "/". This is wrong for at least two reasons.

First, if my browser requests <URL:http://www.some.company/directory>, an HTTP_error_302 is raised, resulting in an extra transaction between browser and server to correct the URL to <URL: http://www.some.company/directory/>.

It works, but it generates extra traffic, which contributes to an already crowded Net. Second, consider a Web server, like Zeus (http://www.zeus.co.uk/), that actually does content negotiation. You don't, for example, put extensions on image files. Instead of <IMG SRC="/images/mypic.gif">, you would write <IMG SRC="/images/mypic">.

The server looks at the HTTP_ACCEPT string and determines whether the browser can display GIF, JPEG, XBM, etc., then serves the best or smallest image accordingly. So, if we have a directory called /images/mypic/ but refer to it as /images/mypic, aren't we potentially in trouble?

Adam Shaun Nealis
adam@lbs.lon.ac.uk

I think you're right on both scores. I do try to include the trailing slash to avoid the extra bit of negotiation you describe. That's pretty well known. But the second case you bring up is really interesting. I've been only vaguely aware of progress in standards for content negotiation, but if it ends up working in the way you describe (i.e., no file extension means negotiate best type), then that would certainly be another reason we should all try to be more precise about trailing slashes. —Jon Udell, executive editor

MMX Misaligned

On reading your article on MMX performance optimization ("Programming Strategies for Intel's MMX," August), I find the example stack prologue code on page 64 does nothing to cause 64-bit alignment, only 32-bit alignment. The alignment mask should be 0FFFFFFF8, not 0FFFFFFFC.

Jan Bottorff
janb@pmatrix.com

You are correct. The assembly code listing in the text box "Maintaining Stack Alignment" contained an error and, as a result, aligns the stack to 32 bits. In order to align the stack to 64 bits, the alignment mask should be 0FFFFFFF8, as shown below.

```
Prologue:
push   ebp              ;save old frame ptr
mov    ebp, esp         ;make new frame ptr
sub    ebp, 4           ;make room for stack ptr
and    ebp, 0FFFFFFF8 ;align to 64-bits
mov    [ebp], esp       ;save old stack ptr
mov    esp, ebp         ;copy alignment ptr
sub    esp, FRAMESIZE ;allocate space
```

—Bev Bachmayer, Intel Corp.

Free PCs!

How is the system Gary Tripp describes in "Forget $500 PCs: How About Free Ones?" (Bits, August) fundamentally different from the old mainframe model? The details may differ, but we still have terminals gaining access via communication lines to a central store of information and using a central, remote processor for anything beyond trivial or presentation-related tasks. Isn't this what personal computers were invented to get us away from? And isn't it a recipe for generating insatiable demand (presuming the cost can be made acceptable) for bandwidth? The basic idea of the personal computer was and is personal control over the physical computing machinery, as well as avoidance of the bureaucracy and high priesthood that inevitably develops around a mainframe or its network equivalent, along with the requirement that you pay every time you use it. Recall how IBM became great: by leasing computing power, not selling it. When networks become the computer, at least in the form promoted by the "Web PC" types and Microsoft, computing is no longer personal; it has returned to the mainframe orientation we once rebelled against.

Mike Brady
73720.1544@compuserve.com

The PC revolution has brought us cheap computing power, but it's not cheap enough. The only way to get computing into the hands of the 75 percent of the U.S. population and 95 percent of the rest of the world that currently lack access is to change the model from a software and hardware base to a service base. Leasing won't work. Most people who need access wouldn't qualify, and necessary hardware and software upgrades require short amortization cycles. The "free PC" is a return to the central computing model, but with two changes: It is offered to the public, and it is fundamentally mobile. A service-based approach that uses PC servers connected via radio modems can give everyone access to e-mail, faxing, accounting, word processing, and the Internet, plus secure personal data storage, for about $20 a month. This approach recognizes bandwidth limitations by placing the central processor close to the user at the local ISP and connecting everyone by radio-frequency cells. Using templates stored in the "free PC" rather than applications to do most tasks reduces local processing and the amount of data transmitted. Internet usage is the bandwidth hog in the model, but if you strip out the graphics, the data stream becomes small. The "free PC" will provide mobile access but will not replace the PC for more intensive computing uses.
—Gary Tripp

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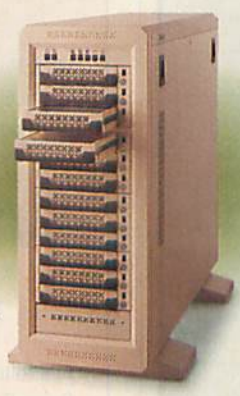

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FIXES

Due to an editing error in "Adieu, Pentafluge... Hello Cyrus" (August), we described Jerry Pournelle's new Cyrix 6x86 machine as having an "EIDE CD-ROM drive running off an Adaptec Ultra SCSI board." We meant to say it has an EIDE CD-ROM drive, and a 4-GB Fast SCSI-2 hard drive running off an Adaptec Ultra SCSI board.

Due to an editing error in "Future Watch" (Bits, August, page 28), we wrote: "Because it runs at only 70 nanoseconds, EDO RAM incurs wait states at higher speeds." The sentence should have said: When running at 70 nanoseconds, EDO RAM incurs an additional wait state in systems with 66-MHz or faster bus frequency.

In our news story "Cyrix 6x86 Matches Pentium" (Bits, September), we neglected to include the SYSmark/32 benchmark results for a baseline Cyrix 6x86-based PC, without 64-MB cache. That number, 159, is comparable to the score of a 200-MHz Pentium Dell, which pegged a 161.

COMING UP IN NOVEMBER

STATE OF THE ART

NEW CHIP TECHNOLOGIES

BYTE takes an in-depth look at how new CPUs will alter system design. We'll examine the recent evolution of Intel processors, from MMX technology to what we've learned about the P7 (Merced); look at chips designed to run Java applications; and bring you the latest news from October's Microprocessor Forum.

SPECIAL REPORT

OPERATING SYSTEMS

BYTE reports on the rise of 64-bit OSes, from existing examples, like SGI's Irix, to future possibilities, like Hewlett-Packard/SCO's joint project. We'll also check the progress of Microsoft's Cairo and analyze the technical merits of Apple's Copland.

CORE

PARALLEL PROCESSING FOR THE MAINSTREAM?

Dick Pountain reports on Bulk Synchronous Parallelism, a new programming model that promises portability between different parallel-computing architectures.

REVIEWS

NSTL HARDWARE LAB REPORT

NSTL rounds up systems based on Intel's leading-edge 200-MHz Pentium Pro processor.

THREE-TIER CLIENT/SERVER DEVELOPMENT TOOLS

In a follow-up to our June Software Lab Report, NSTL tests PowerBuilder 5.0 from Powersoft and Centura Application Server from Centura (formerly Gupta). Both upgrades offer important new application-partitioning features for distributing your application's objects over a network.

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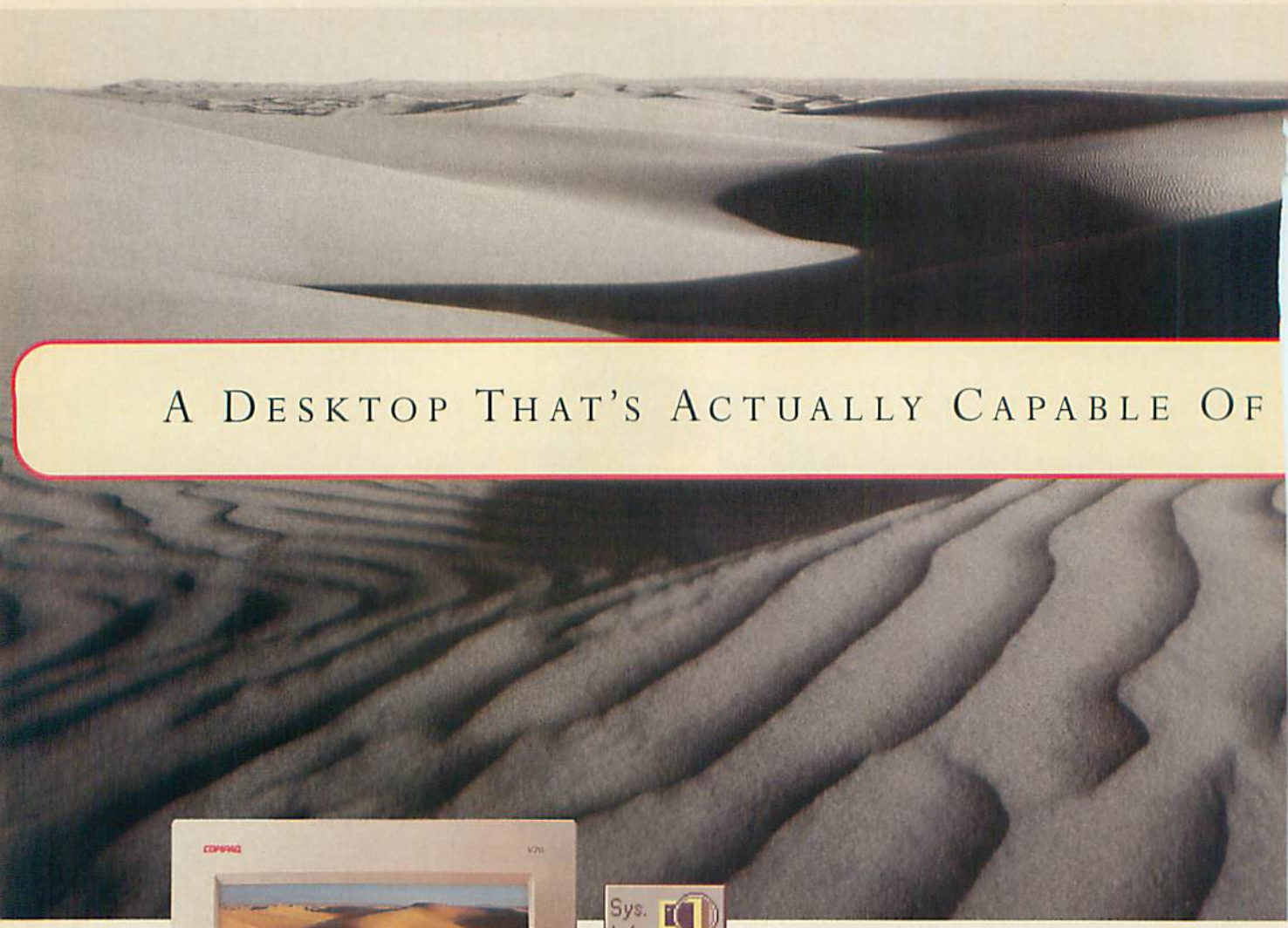

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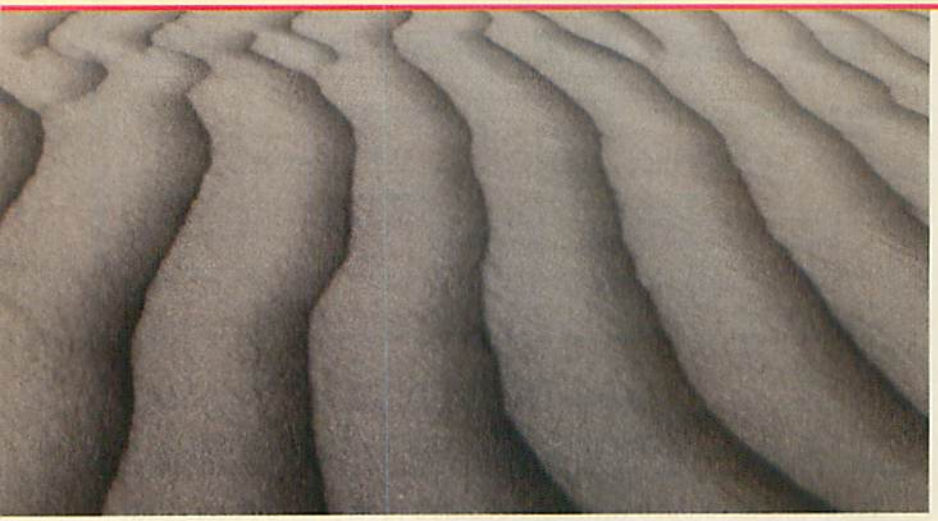

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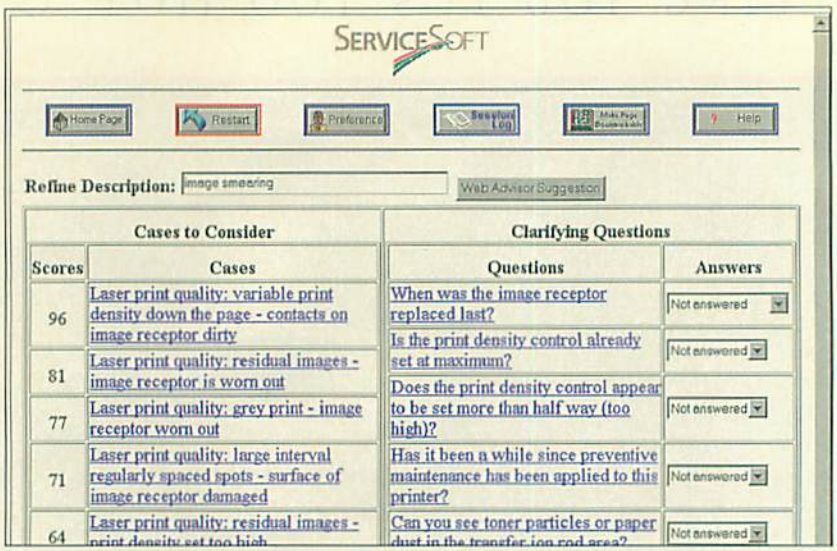
Has It Changed Your Life Yet?

Self-Help Software to the Rescue

Call-avoidance software helps companies improve customer support and reduce expenses.

New programs for the Web let beleaguered technical-support departments reduce costs and improve service by helping users help themselves. Tech-support calls are the bane of the computer industry. They cut into profits—as much as $20 per call—and often make frustrated users wait, usually at their own expense. To reduce the number of support calls a help desk has to field, companies are turning to a new breed of product known as call-avoidance software.

Expert systems are not new: Companies have used them for years to help their support personnel find solutions more quickly. The new trend is to put answers directly into the hands of the user, potentially bypassing the tech-support phone call altogether. And the new vehicle for delivering that knowledge is—you guessed it—the Web.



Programs developed with ServiceSoft's tools provide users with several possible solutions, with the most likely presented at top.

"Call-avoidance programs such as our Web Advisor and Knowledge Builder won't solve every problem out there," says Keith Loris, vice president of development at ServiceSoft (Needham, MA), which recently released its first authoring tools for building Web-based problem-solving systems. "But they can reduce the number of phone calls a technical-support department has to handle. They can also ensure that the answers users get are consistent."

Some call-avoidance software goes a step beyond telling users how to fix a problem: Instead, the program fixes the problem automatically. For example, SystemWizard, from SystemSoft (Natick, MA), will detect, diagnose, and, in some cases, automatically fix common PC problems. SystemWizard, which should start appearing in several vendors' Win 95 and NT PCs by the end of this year, comprises several components, including a client application with a built-in local knowledge base of problem/resolution data, a server that provides a second level of support, and a knowledge

geek mystique

By our count, viewers watching the Summer Olympics on TV were, on one night, inflicted with 91 ads between 8 p.m. and midnight. Of those 91 ads, seven (about 8 percent) listed Web addresses. The Web-aware advertising companies were Reebok, Kodak, NBC, and Xerox and IBM (both twice). The next day, in the Boston Globe, we counted 121 display ads, six (5 percent) of which had Web addresses. – Jason Krause

Other Web Statistics

- Estimated percentage of adults in the U.S. using the Web: 7.7
- Estimated volume of sales generated by the World Wide Web in 1995 (in millions of dollars): 436
- Projected sales to be generated by the Web in 1998 (in millions of dollars): 46,000
- Number of U.S. states with organized programs for schools on NetDay '96: 27
- Number of Internet service providers worldwide (as of July): 3054
- Estimated size of Internet access market in 1997, in billions of dollars: 2.5
- Proposed tax on Internet access providers serving Tacoma, Washington: 6 percent
- Number of U.S. states taxing on-line services: 6
- Number of domains in .COM: 316,271
- Number of private Internet providers in Egypt: 7

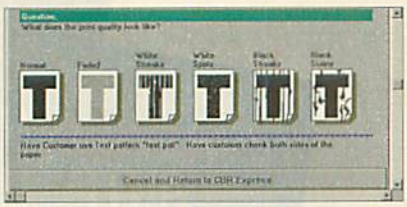
– Win Treese

builder for use by a PC vendor or MIS department to add solutions as new problems occur. If SystemWizard doesn't find a solution in the local database, the program can dial up a server, either over the Internet or the phone lines. The server can also automatically fix the problem by downloading a software solution or making some other modification.

By including a prebuilt database of solutions in SystemWizard, SystemSoft also eliminates a potential drawback to expert systems: the amount of time required for an organization to develop a comprehensive help system.

"Authoring is clearly the biggest issue," says Keith Sturdivant, manager of advanced support technology at Microsoft, which is increasing the number of self-help solutions it puts on the Web. "Maintaining the content and ensuring that the information is accurate and current in the database is important. And if you have a broad range of issues to address, as we do at Microsoft, that becomes much harder to deal with."

One difficulty is that technical-support people are often too busy solving the latest customer problem to sit down for half a day or even an hour to get information out of their brain and into the



Problem resolution can be more visual than with a phone call, as shown in this application using Inference's Casepoint.

expert system. Writing a self-help program that solves problems for people who have little or no inkling about what is causing their technical difficulties still involves extensive work, even when using authoring tools that require little or no programming.

"Providing a solution for a user who doesn't have any idea what's wrong requires pretty intense authoring," says Erik Stackhouse, technical-support representative at Internet service provider UltraNet (Marlboro, MA), which is currently developing solutions using authoring products from ServiceSoft. "In that situation, you have to ask the user a lot of questions. There are so many factors involved that, from an authoring standpoint, it might be more work than it's worth." This is why companies such as UltraNet often start with a self-help system that specifically addresses a subset of common problems that can be easily solved, usually by an intermediate or advanced user. Situations involving more complex questions, novice users, or a computer that can't even get onto the Net will still require a voice call.

But even if the first implementations of Web-based self-help systems divert only 20 percent of incoming tech-support calls, this would be a huge improvement. And many vendors say that after an initial pilot phase, they plan to roll out larger, more comprehensive applications that will eventually handle 50 percent or more of incoming calls. In those situations, it's critical that call-avoidance authoring tools be able to integrate with legacy problem/resolution databases and call-tracking programs. And here the Web may again play an important role. A browser can be a single access point to a myriad of data sources, provided those databases can export into the Hypertext Markup Language (HTML) format. "If you're making the effort to author, you want it to be accessible to as wide an audience as possible," says UltraNet's Stackhouse. "Doing it on the Web is probably the best way to make this work on a large scale." **– Dave Andrews**

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yeah, but...

A controversy swirling around the release of NT 4.0 involves Microsoft's limiting to 10 the number of computers that can connect simultaneously to NT Workstation. To support more than 10 people, you have to use the more expensive NT Server, which sells for about $1100. Microsoft officials say they are justified in this practice, since they have not tested NT Workstation to ensure it can support heavy usage (for example, as an Internet Web server).

Yeah, but this practice puts other vendors of Web server programs at a disadvantage. Microsoft provides a free Web server program with NT Server. Microsoft's 10-user licensing restriction essentially prevents other vendors from selling Web software that runs on the less expensive ($319) NT Workstation at an overall cost that's less than NT Server. Competing on the NT Server field means Microsoft's competitors have to play against a free product.

Microsoft can put whatever restrictions it wants on its products. If people want to use NT to host Web sites, they can upgrade to NT Server.

Yeah, but Microsoft's policy will make customers who want to use NT as a platform for Web servers pay more. And other vendors say NT Workstation easily supports more than 10 users connected simultaneously to a Web site. They also argue that Microsoft already backed down from its plan to build the 10-user limitation into the NT Workstation software. But then why did Microsoft reintroduce the limitation by putting it into its licensing agreement?

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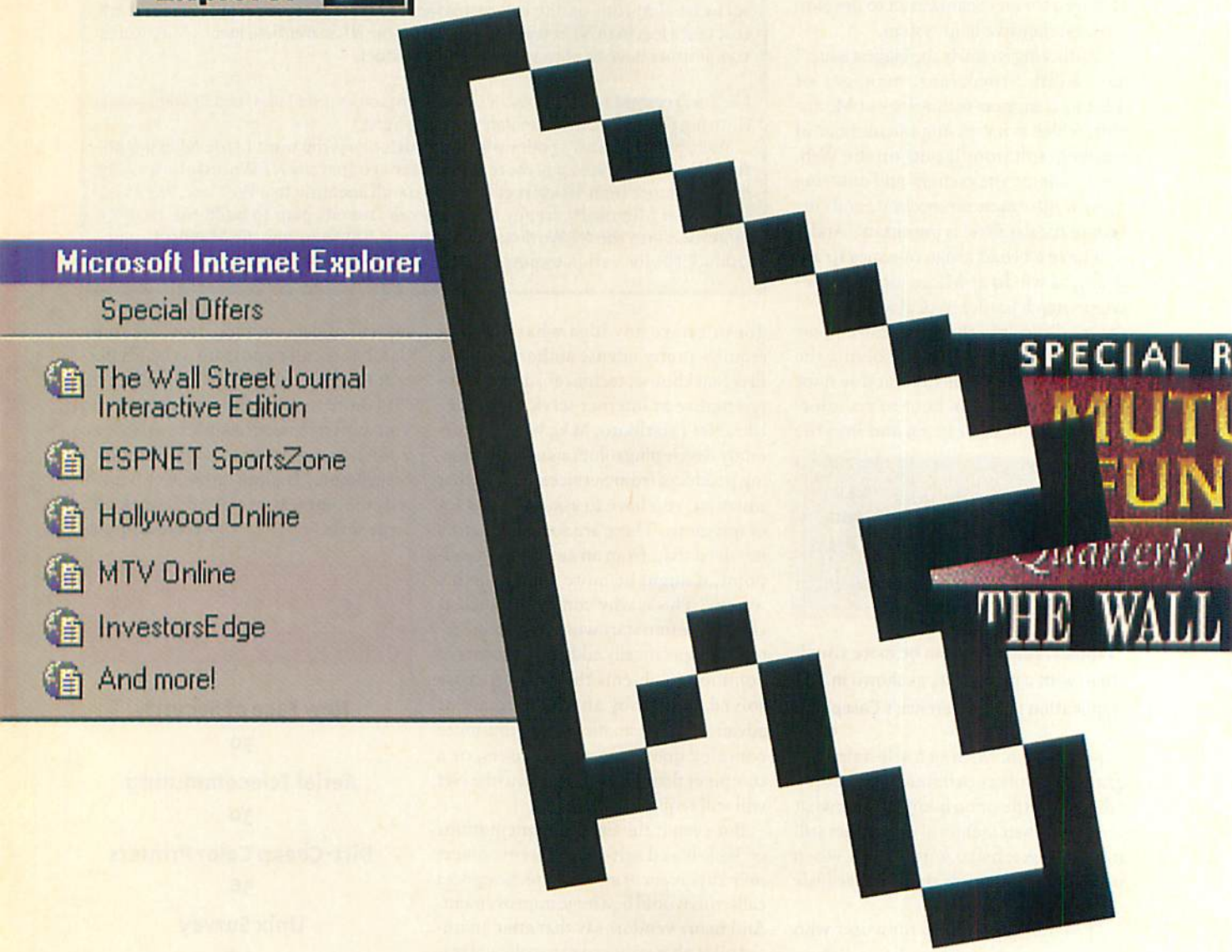
Microsoft Internet Explorer 3.0

Microsoft Internet Explorer



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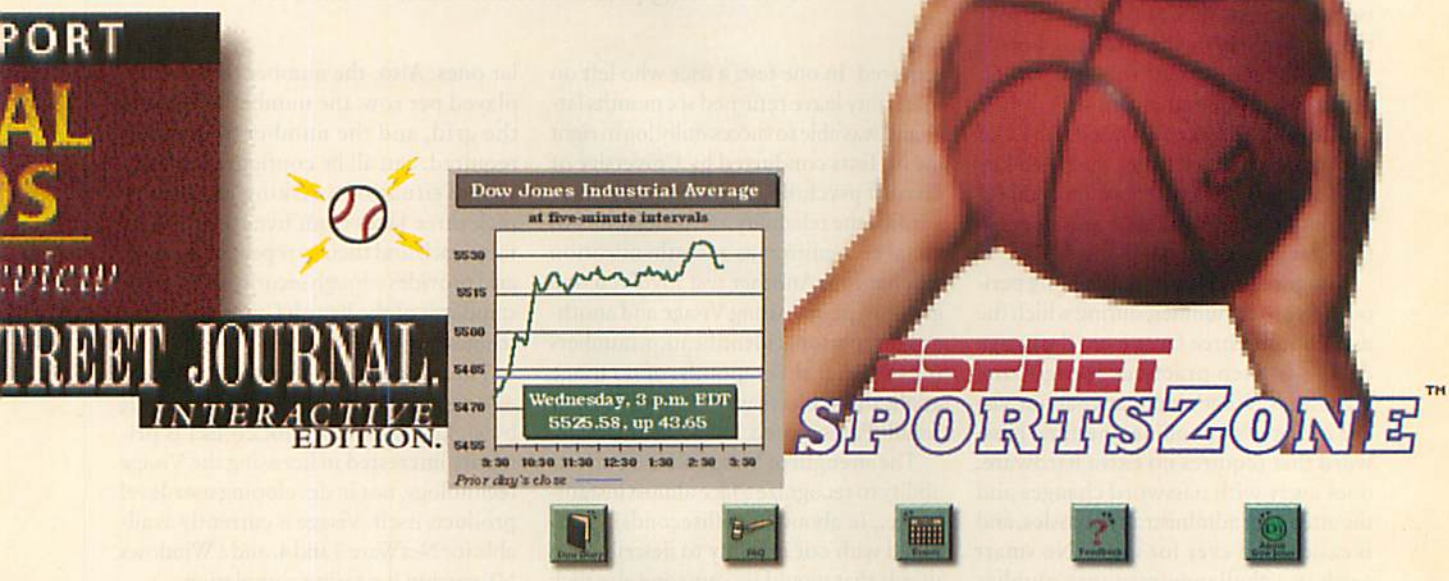

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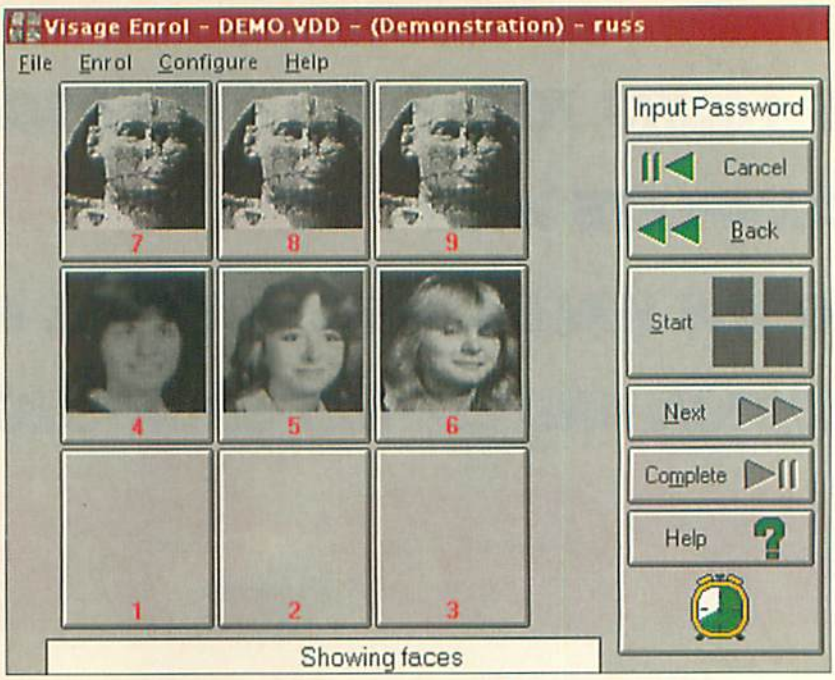
Security Gets a New Face

Here's a twist on security that gives new meaning to the word "facetime." The old definition of facetime involves trying to remember people's names as you mingle at parties. But for the U.K. company Visage Development, facetime refers to an authentication mechanism that requires users to recognize a series of faces before they can access their computers.

Instead of asking a user to remember a password or carry an authentication token, the Visage program presents a row of three faces, some of which the user has learned to recognize. Faces are typically 16-level gray-scale images, 50 pixels square, and each has a number. The faces appear for about a second before they're covered up by a masking image that hides the pictures from bystanders. Then another row of faces appears for a second and is covered up. Finally, a third row (see the screen shot at right). The user types in or clicks on the three numbers of the faces recognized; this is verified, and access is granted or denied.



Visage asks users to recognize faces, rather than remembering personal identification numbers.

The faces are taken from a database of generic faces. Each time, the three key faces appear in different positions, and the surrounding faces are randomly selected from the rest of that database.

Visage requires an initial training period of five to 10 minutes, during which the user chooses three faces from the image database, then practices recognizing those faces. What's innovative about Visage is that it's a genuine one-time password that requires no extra hardware, does away with password changes and the attendant administrative hassles, and is easier than ever for users. No smart cards, no challenge-response number pairs, and no fingerprint readers are required. In one test, a user who left on maternity leave returned six months later and was able to successfully log in right away. Tests conducted by University of Cardiff psychologist Hadyn Ellis have verified the reliability and recallability of facial recognition as an authentication mechanism. Another test involved one group of people using Visage and another using personal identification numbers (PINs). After three months of no usage at all, the subjects were tested on their recall: Faces scored 100 percent, PINs 0.

The strength of Visage is based on our ability to recognize a face almost instantly (i.e., in about 20 milliseconds), combined with our inability to describe it in words that would let someone else pick out that same face from a group of similar ones. Also, the number of faces displayed per row, the number of rows in the grid, and the number of matches required, can all be configured to individual situations. Asking the user to pick three faces from five rows of four faces each and then to repeat with a new grid provides enough security to meet the standards of the British Computer-Electronics Security Group.

The company (contact William Visick, +01442 230471; fax +01442 212142; bvisick@cis.compulink.co.uk) is primarily interested in licensing the Visage technology, not in developing user-level products itself. Visage is currently available for NetWare 3 and 4, and a Windows NT version is nearing completion.

–Russell Kay

future watch

Coffee, Tea, or FTP?

Communications for air travelers in the future won't be so disconnected or rely so heavily on battery-powered notebooks. Delta Air Lines (Atlanta, GA), in partnership with Olin Aerospace Company (Redmond, WA), has already begun testing its first in-seat power supply system. Passengers on the airline's Spirit of Delta Boeing 767 can sit down, plug in their computers, and not worry about battery power. Other airlines are also evaluating similar in-flight power systems.

Further out are communications systems that would let airplane passengers browse the Web live. Systems such as Airview, from a company called The Network Connection (Alpharetta, GA), combine video entertainment, catalogs, PC games and applications, and possibly Web access. With Web access, travelers could send e-mail or browse competitors' sites. However, before live Web access is possible, the satellite network that planes currently use for in-flight phone and fax services will need upgrading. And there's another matter. "Before deploying any next-generation communication system," says a spokesman for United Airlines, "we're going to take a close look at how much weight they add to the airplane!" –DA

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Vendors Battle Over Next Internet File System

Browser wars, step aside. The next battle looming in cyberspace is over which file system will provide the underpinnings for better file transfer and group collaboration services on the Internet. Such a file system, whether from Sun or Microsoft or some other vendor, would improve upon the Internet's current HTTP and FTP.

Sun's proposed new standard, the Web Network File System (WebNFS), is just what the Web needs, claims Brian Croll, director of marketing for Solaris Servers at Sun. "The Internet is like a dirt road with a lot of potholes. One of these potholes is the slow speed of file transfers," Croll says. An advantage of WebNFS is its superior performance over FTP and HTTP for transferring large blocks of data, Sun says. WebNFS also lets you edit documents instead of simply viewing them as you do in today's browsers. This read/write capability will allow vendors to develop applications that let you collaborate with others from within your Web browser or Web-enabled application, without having to cut and paste text from the browser into another program.

Sun's NFS has been the TCP/IP file distribution standard for more than a decade. Not tied to any architecture or operating system, NFS is the glue that holds together heterogeneous file systems. Until recently, there hadn't been an open implementation that would work consistently over Internet connections. But with Sun's submission of WebNFS to the Internet Engineering Task Force as a proposed open standard, that's no longer true.

WebNFS springs ahead of the Net's hypertext (HTTP) and data transfer (FTP) protocols because neither of them are network file systems. HTTP must constantly close and open sockets to transfer information, and both HTTP and FTP require high latency between packets. WebNFS cuts down on both the interprocess communication and latency factors. This results in WebNFS offering block file transfers that are up to 10 times faster than the current versions of HTTP and FTP, Sun claims.

WebNFS already has powerful supporters, including Oracle and Spyglass, who are incorporating it into their browsers. Auspex, IBM, and Sequent plan to include WebNFS in their Web servers. Sun, of course, is putting all its resources behind WebNFS. The most visible sign of this support is the Netra NFS file servers, which depend as much on WebNFS as they do on HTTP for data transfer.

However, two prominent names are missing from the list of WebNFS adopters: Microsoft and Netscape. HTTP and FTP leave much to be desired for seeking, reading, and writing operations, agrees J Allard, a program manager at Microsoft. But Microsoft's remote file access protocol, called Common Internet File System (CIFS), complements HTTP. CIFS is based on the company's service message blocks (SMBs), which are already used in existing network components of Windows and NT, Allard notes, as well as on Unix.

Allard finds Sun's WebNFS speed claims to be somewhat disingenuous. "Byte Read-Range and HTTP connection keep-alive is evolving HTTP into a rival for WebNFS," he says. According to Allard, it may be too late to expect the entire Internet community to make a fundamental shift from HTTP to a new standard for file transfers.

Netscape, usually a staunch Sun ally, is still evaluating WebNFS, according to Andreas Cook, product PR manager. "Even if we turn it down now, we may use it in the future," he says.

"The big powers of the Web will fight over WebNFS. If Sun is successful, adding WebNFS will require many companies to retrofit their servers and browsers," says Ross Rubin, senior analyst for Jupiter Communications (New York City), a research firm that covers consumer online services and the Internet.

WebNFS is a threat to Netscape, says Stephen Auditore, president of Zona Research, an Internet market research house. "WebNFS plus Java is a direct competitor to HTTP and HTML," he says. "If Sun is successful in replacing the existing infrastructure, all the other major Web companies are in serious trouble." According to Auditore, Netscape is balking because WebNFS/Java would undercut all its technology dollars.

As for Microsoft, "Redmond already has its own distributed file system oriented to the NT environment and SMB, and they would love to see it expanded onto the Net," Auditore says. After all, whichever company controls the standards also controls the marketplace: WebNFS's success or failure could drastically influence Sun's and other companies' revenue streams.

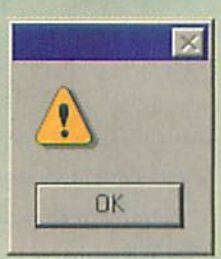
Will WebNFS become the Net standard? "A lot will depend on whether Sun can gain the mind share of people using other third-party HTTP servers," says analyst Rubin. "If someone ports WebNFS to popular freeware servers, like Apache, it will be a matter of time until people start hacking together WebNFS add-ons for both Netscape's and Microsoft's browser and server product lines." If that happens, then the Web could be completely reinvented with WebNFS as its standard.

– Steven J. Vaughan-Nichols

Bug of the Month

cc:Mail: Not OK

A BYTE editor found this interesting dialog when attempting to read new e-mail using cc:Mail 2.01 under Win 95. After the editor logged in, cc:Mail announced that he had new mail. When the editor attempted to read the new e-mail, the dialog message at right appeared. When he attempted to close the dialog box, he got the dreaded ringing-bell error sound. Clicking on another application minimized the dialog, and attempting to read cc:Mail caused another instance of the same error message. Now bells were ringing in stereo. The quick-and-dirty solution: Close cc:Mail and all other applications, reboot, and try again. The next time, everything worked as expected.



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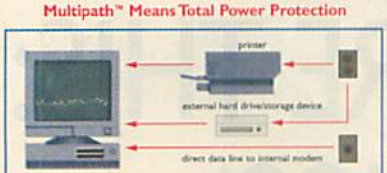

Bad power (red) can enter a computer system through multiple paths – eg. printer, data and phone/fax lines – even if computer A/C is protected.

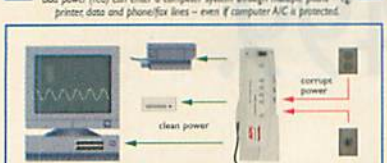

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Photo Quality Arrives for Low-Cost Printers

Ink-jet printers were once the poor substitute for people who couldn't afford a laser printer. Now, these inexpensive devices are delivering much that laser printers can't, including near-photorealistic images at a fraction of the price.

Improvements in ink formulations, dot-placement accuracy, and better software are all combining to produce the best-looking color ink-jet output yet for personal desktops. And the prices are coming down to staggeringly low levels for this type of output.

An excellent example is Epson's Stylus Color 500C, which puts the company's 720- by 720-dots-per-inch (dpi) output technology in a printer expected to sell for about $279. The 500C produces sharp black text, but the real attraction is the photo-quality output. Samples printed on coated stock were as close to conventional photographs as we've seen from a color ink jet, regardless of price. The Epson prints black text at up to 4 pages per minute (ppm) and color at about 1 ppm or slower.

Hewlett-Packard is countering with its midrange model, the 693C. This printer produces laudable photo-quality output in its basic mode, but HP has added an optional ($49) photo cartridge for even higher-quality output. Inserting the photo cartridge in place of the black ink cartridge produces a much wider range of possible colors, resulting in smoother and better looking output. The results we saw were very impressive, making the HP competitive with the Epson, though it is somewhat more expensive ($349) and does not come ready to work with a Mac.

Canon's latest iteration of its BubbleJet technology is the BJC-4200, which prints at 720 dpi for crisp, lifelike images. Canon offers specialty neon inks for the BJC-4200, though it has no photo-specific inks like HP. List price is $399. Canon's BJC-240, also new, sells for $179, but it's slower than the BJC-4200: 4 ppm in black and white and way under 1 ppm in color

Lexmark's latest, the Color Jetprinter 2050 ($299), prints black or four-color output at 600-dpi resolution. The company rates its speed as up to 5 ppm in black and 2 ppm in color. Lexmark offers an accompanying line of special paper for high-quality photographic reproduction.

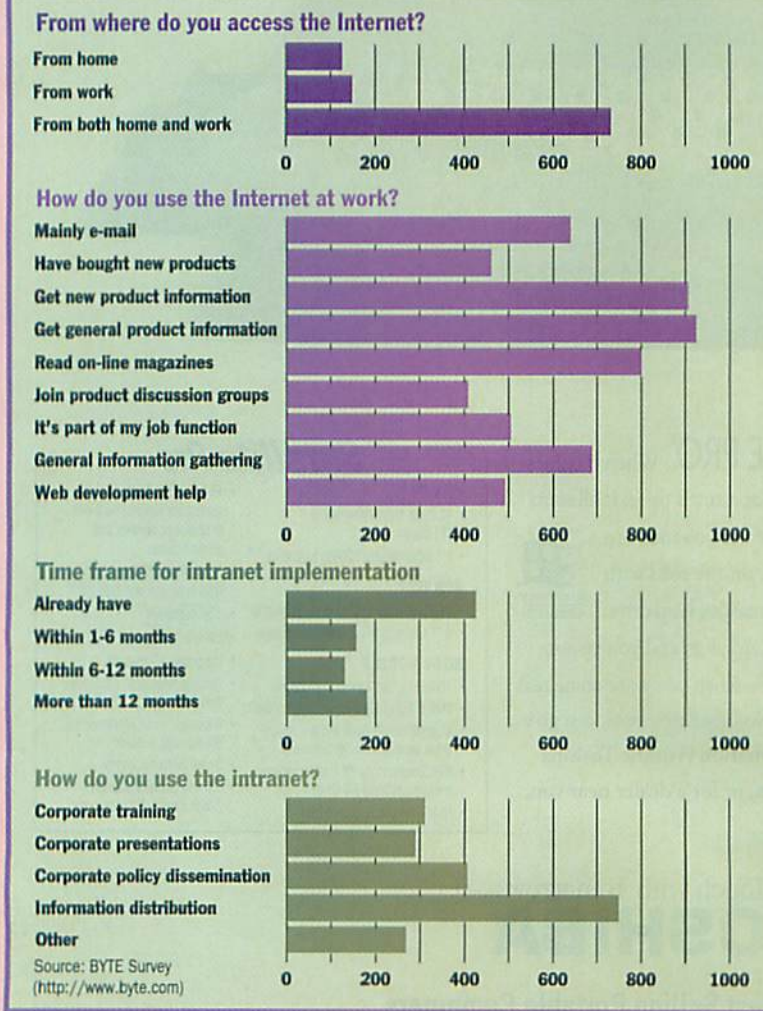
These color ink jets aren't perfect. They are slower than laser printers when it comes to high-volume black-and-white output, and they can be very slow when producing photo-quality color pages (as much as 3 minutes or more a page). Still, at these prices, they make color printing very affordable. **– Jon Pepper**

COLOR INK-JET PRINTERS

	Text Speed	Color Speed	Resolution	Cost	Photo Color
Epson Stylus Color 500	4 ppm	2 ppm	720 x 720	$279	Yes
Canon BJC-4200	5 ppm	1 ppm	720 x 360	$299	Yes
HP DeskJet 693C	3 ppm	1 ppm	600 x 600	$349	Yes
LexMark Color JetPrinter 2050	5 ppm	2 ppm	600 x 600	$299	Yes

Note: HP and Canon require optional cartridges for true photo color output.

Internet/Intranet Survey



Source: BYTE Survey (http://www.byte.com)

"Now that my company is on the Internet, will a fancy port scanner algorithm make

mincemeat

of my firewall?"

DEFENSE

The Internet lets your company open its doors to millions of potential customers, partners and contributors and, unfortunately, some potentially dangerous hackers, crackers and online troublemakers.

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New Products Make Backing Up Easier

Most PC users look forward to backing up their files about as much as they look forward to a visit to the dentist. They know they have to do it, but they would prefer not to. A new round of products seeks to make the system-backup chore a little less painful.

With its Zip drive, Iomega (801-778-1000; http://www.iomega.com) made backup peripherals, if not the process itself, fashionable. With 100-MB data cartridges, a cool design, and the right price (under $200), the Zip became a best seller, with a claimed installed base of more than 2 milion units. Now, Iomega and others are evolving their backup products into devices that perform a multitude of operations, such as exchanging large data files, archiving, protecting hard drives from viruses, and many other functions. Iomega has followed its 1-GB Jaz drive ($499) with a new version of its tape-backup line, called the Ditto2GB, that offers an intuitive user interface, 2-GB storage capacity, and $149 drive price ($20 per additional tape).

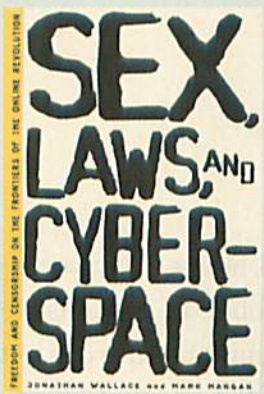
Syquest (510-226-4000; http://www.sales@syquest.com), known for its tape backup products, counters with its EZFlyer, a 3½-inch 230-MB removable-cartridge hard drive ($299). The EZFlyer offers more storage than the Zip, but it's also more expensive. The media itself is inexpensive at $29.95. The EZFlyer is available in both parallel and SCSI versions.

Only about 5 percent of PC users currently have some type of backup or archive device, according to Jim Porter, president of Disk/Trends (Mountain View, CA), a market research firm. "It is too early to tell what technology will dominate, but I am inclined to think none will take over a very high percentage of the PC base," Porter says. "It is like life insurance: People don't need it until they are dead, and they feel the same about backup against failures." However, when the dark day comes that your hard drive fails, you will wish you were among the fashionable minority that uses a backup product.

– JP

Book Reviews

How Free Should Internet Speech Be?



If you believe, as I do, that free speech should prevail on the Internet, you'll find this book a friendly and informative aid the next time you argue this subject. You won't, however, find it a comforting one.

Authors Jonathan Wallace and Mark Mangan take on disturbing denizens of the Net to show why the likes of snuff fiction writers and bomb makers should not be used as excuses for restricting the Internet. Civil-libertarian-minded readers will be chilled to the bone–and their convictions tested–upon reading about the university professor who posted, in an open newsgroup, fantasies of raping and murdering a female student.

Keeping the Net accessible will ultimately place a greater responsibility on all of us to counter that which we find offensive by social, instead of legal, means. In the above case, the authors argue persuasively that prosecuting the professor for conspiracy to commit the acts he'd written about was misguided; more effective and entirely justifiable was his removal by the university from his teaching post.

After an admirable attempt to boil down the legalese of several landmark court cases, the authors conclude that we should treat the Net as a series of printing presses and book stores. They chose this metaphor carefully: A long history of U.S. Constitutional law extends the fullest protection of the First Amendment to those two institutions. In contrast, virtually every advanced communications technology, from telegraph to television, has in some way been restricted by the government.

I found the printing press/book store comparison useful; it cuts through the colorful attempts by some people to portray the Internet as an invasive, irresistible deluge of information. On the contrary, it takes an act of will to connect to the Internet. And this paradigm leaves a place for responsible filtering by on-line services and parents (and room for argument about just what "responsible" means).

Mangan and Wallace sound the alarm about the political and commercial forces who hide behind outmoded arguments to gradually roll back freedom of speech. The Net has the same chance of moving humanity forward as did the first books. Also, like the printing press, new electronic media will disseminate communications ranging from the objectionable to the subversive to the broadly acceptable.

Mark Schlack *is BYTE's editor in chief. You can send mail to him at mschlack@bix.com.*

Practical Help for the Disabled

The personal computer is a powerful tool for opening the world to people with disabilities. How to make it happen is less obvious–and the subject of this book.

The focus and tone are relentlessly practical. Joseph J. Lazzaro (an occasional contributor to BYTE) is less concerned with theory than with what you can buy and use today. You'll find a surprising range of hardware and software to aid people with impaired vision, motor skills, or hearing. The descriptions that make up most of the book (and the shareware and demo programs on the accompanying CD-ROM) summarize the capabilities of each product well enough to let you make a preliminary judgment on its usefulness.

Software developers aren't forgotten. The book includes a developer's guide for writing accessible software; it's full of tips on how to design programs that don't shut out people with disabilities. As Lazzaro demonstrates, a little thought in the design phase can make the difference between software anyone can use and software that excludes people using nonstandard I/O. If you know someone who is disabled, or if you are disabled yourself, *Adapting PCs for Disabilities* is invaluable.

– Rick Cook

Sex, Laws, and Cyberspace	Adapting PCs for Disabilities
by Jonathan Wallace and Mark Mangan; Henry Holt & Company;	by Joseph J. Lazzaro; Addison-Wesley Publishing;
ISBN 0-8050-4767-0; $24.95	ISBN 0-201-48354-8; $39.95

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Evil Empire

virus is and why it brought down the New York office?"

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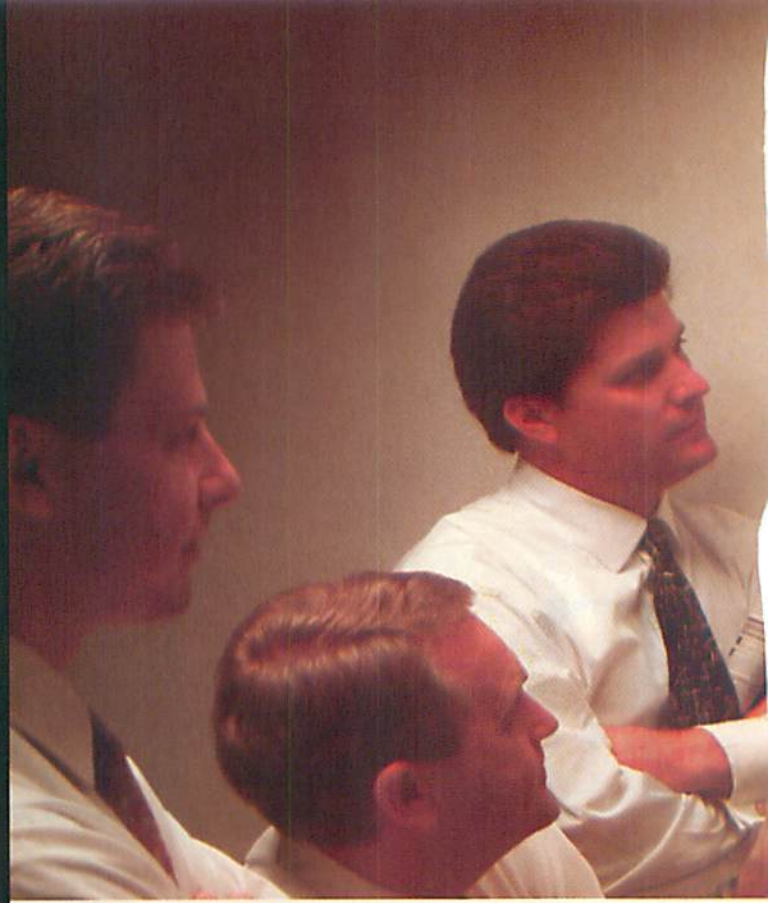
WHEN THE JOB CALLS FOR A PRO



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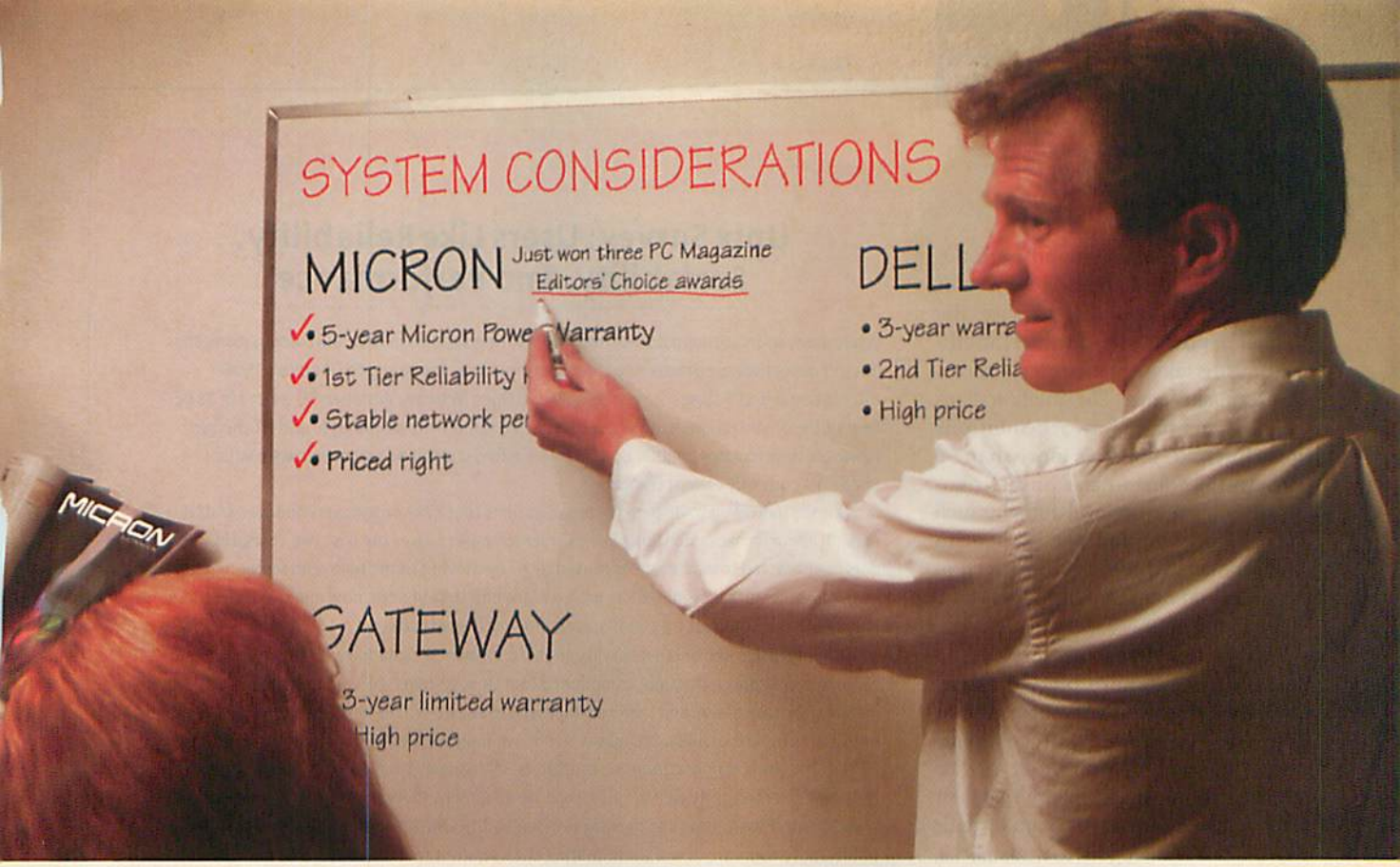

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Web Address COMbat

While the Internet community wrestles with implementing the new version of the Internet protocol that increases the number of possible IP addresses, another struggle is taking place over the shortage of domain names. The situation stems from the fact that Network Solutions Inc.'s InterNIC controls more than 90 percent of all domain names in this country, including the top-level domains such as .com, .edu, .gov, and .net. With such a limited number of domains, the selection of good domain names appears to be shrinking.

But is there really a shortage? Rosalind Resnick, president of NetCreations (Brooklyn, NY; http://www.netcreations.com/), an Internet software and marketing company, doesn't think so. The problem of companies who can't get their favorite name into the domain of their Web address is analogous to trademarks, she says. "If someone already has your name [in their Web address], then you have to come up with another name. After all," Resnick points out, "in the real world, you can't start up a fast-food chain called McDonald's because that's already been trademarked."

But that doesn't stop people from wanting just one name and no other for their domain. In that sticky sort of situation, a vendor can turn to AlterNIC (http://www.alternic.net), which lets a company get the key words it wants in its Web address by using alternative top-level domain names. By giving enterprises more opportunities to have the name they want, AlterNIC argues, it fulfills consumers' desires and helps prevent businesses from slugging it out over who gets what domain name.

Sounds good, but there's a storm looming. InterNIC believes it is the sole gatekeeper of top-level domain names and that attempts by other companies to infringe on that responsibility interfere with its legal right to control domains. Whether AlterNIC is successful in freeing up top-level domains is an open question. But it seems certain that as more companies put marketing and sales operations on the Web, some opening up of top-level domains is certain to happen. **– SJVN**

Datapro Report

Unix Survey: Users Like Reliability, Scalability, and Performance

While many users are including Microsoft operating systems in their purchasing plans, that doesn't mean they are downsizing their plans for Unix. According to Datapro's 1996 International User Ratings Survey on Unix and Open Systems, Windows NT is used in 38 percent of the organizations surveyed, and 23 percent more are planning to add NT this year. However, Unix remains popular due to its flexibility, scalability, and power, with which Microsoft currently cannot compete.

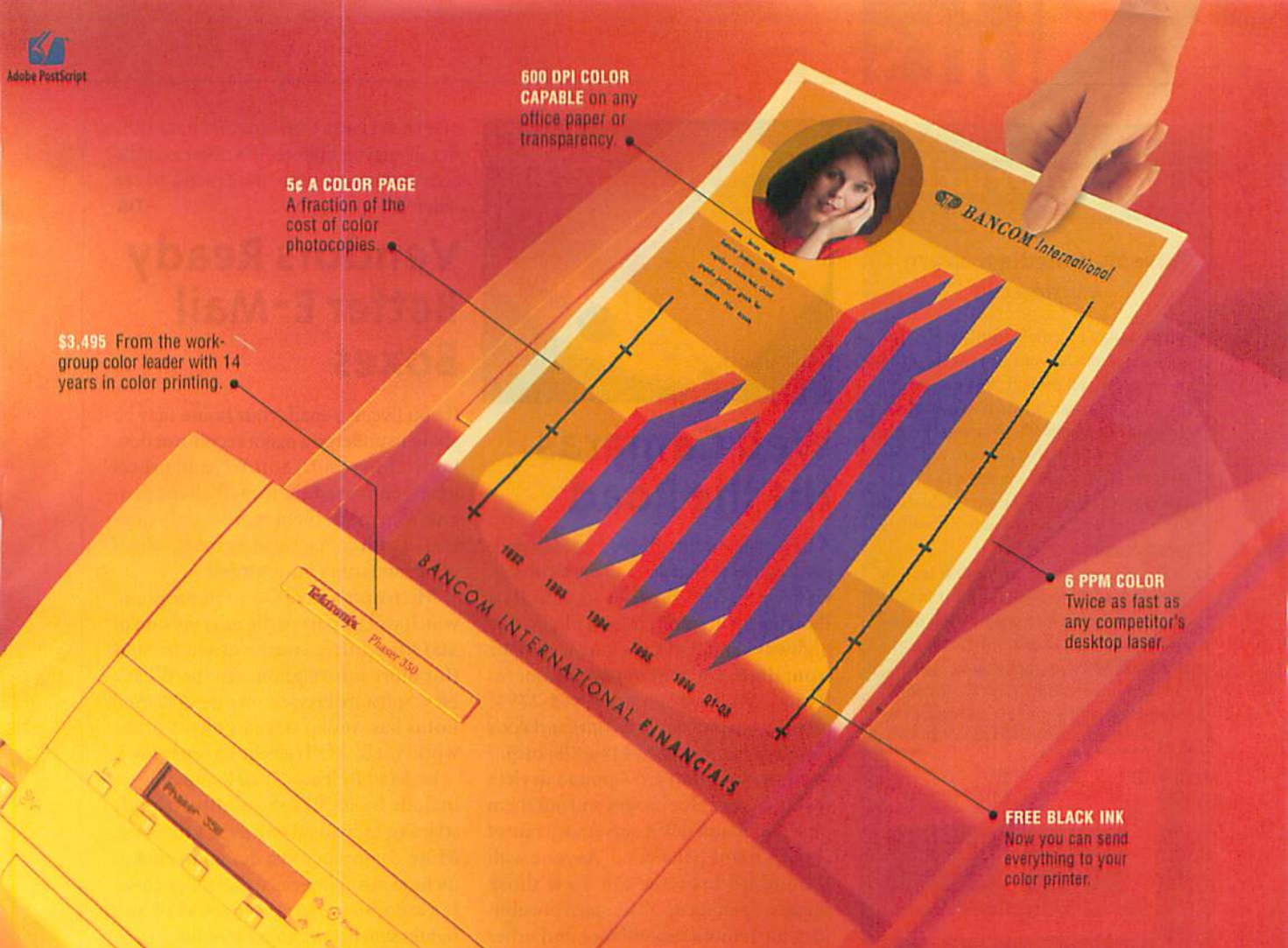
NT is the logical upgrade path for organizations that have outgrown Windows, and NT is making major inroads into Unix's low-end server market. Over the past two years, Unix vendors have reacted to market shifts caused by NT by moving to the high-end server market. For example, SCO, once considered the premier low-end Unix vendor, now markets its OS as an enterprise-class product for client/server and host-based systems.

Although users like Unix's reliability, high performance, scalability, interoperability, and client/server support, they also complained that Unix systems still cost too much, and that installation, ease of use, and user interfaces could be better. One version of Unix that received high marks for affordability is Linux, which is available for free or for a nominal CD-ROM charge. The Linux ratings cannot be considered statistically valid, but it's interesting to note that the OS scored quite well in ease of use, development tools and utilities, and of course price. It didn't score as well as the others in scalability. One reason could be that ports of Linux to RISC processors are newer to the market than versions for Intel-based PCs.

Over the years, one common complaint with Unix has been that it's too expensive. If Linux had been available 10 years ago, one can't help wonder what its impact would have been. **Mary I. Hubley**, *principal analyst. For more information on Datapro Information Services: (800) 328-2776; (609) 764-0100; http://www.datapro.com.*

Product	IBM AIX	Digital Unix	HP-UX	SCO*	SunOS/ Solaris	System V	Linux
Number of responses	181	81	224	202	297	114	33
Client/server support	3.5	3.6	3.7	3.4	3.9	3.5	3.4
Development tools/utilities	3.1	3.2	3.4	3.1	3.6	3.1	3.8
Interoperability/ communications	3.6	3.7	3.6	3.2	3.9	3.5	3.7
Performance	3.6	3.9	3.8	3.4	3.7	3.7	3.6
Scalability	3.6	3.5	3.8	3.2	3.7	3.7	3.1
Security	3.2	3.3	3.3	3.2	3.2	3.3	2.8
User interface	3	3.2	3.4	2.7	3.2	2.8	3
Ease of installation	2.9	3.1	3.2	2.8	3.2	3	3
Ease of use	3.1	3.3	3.3	2.9	3.1	3.1	3.4
Price	2.7	3	2.9	2.8	3	2.9	4.7
Reliability	3.6	3.7	3.9	3.4	3.8	3.8	3.8
Maintenance/support	3.4	3.3	3.6	2.9	3.3	3.4	3
Overall satisfaction	3.3	3.4	3.5	3.1	3.5	3.3	3.5

Ratings are on a 5-point scale, where 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent. *(Unix, Xenix, Open Desktop, OpenServer)



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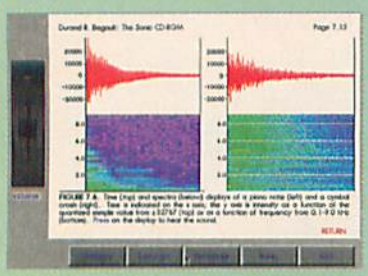
cd-rom review

Use Multimedia to Learn Multimedia

With today's new point-and-click authoring tools, anyone can toss together a multimedia project. But mastering the text, audio, video, hyperlinks, and varied production skills often required in creating a CD-ROM, Web page, or business presentation is another matter. The Sonic CD-ROM for Desktop Audio Production focuses on one special aspect of multimedia: sound.

The disc offers a thorough lesson in audio production basics, and it makes good use of plentiful examples. This product will be most useful for technicians who want to polish their sound skills.

Another valuable CD-ROM for audio production is the IEEE's Standards in



The Sonic CD covers techniques of audio production.

Computer Generated Music. This CD offers essays and documents concerning desktop music publishing, MIDI, high-level music programming, digital audio, 3-D sound, multimedia, and computer-assisted instruction.

The amount of information varies from subject to subject. The CD may disappoint people interested in a specific angle (e.g., only one study covers 3-D sound). Overall, however, this disc delivers practical information for audio developers on a wide variety of topics. **–Jason Krause**

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Web Cameras Hit the Road

A new type of diminutive network gadget—cameras that snap images you can view with a Web browser—could start showing up in some unusual places, like highways and hallways and even your front door. Current network cameras from Microplex (800-665-7798; http://www.microplex.com) and Axis Communications (800-444-AXIS; http://www.axisinc.com) are 1-pound devices that can take color images and put them on self-contained Web servers at a rate of about 1 frame per second. Anyone with a standard browser can view those images, opening up all kinds of possibilities for remote surveillance and other types of applications that can take advantage of the Web.

The drawback with current versions of the Axis and Microplex products is they don't have serial ports; instead they use standard Ethernet UTP connections to a network. Both companies say they are planning new versions with serial ports. That would let a modem transmit the images over a standard phone line, thus providing much more flexibility in camera location. Who knows? Maybe one day commuters will rely on Web-enabled cameras placed along popular travel lanes to avoid rush-hour traffic; or maybe high-tech workers on the coast will use a network camera to see when the surf is up. **–DA**

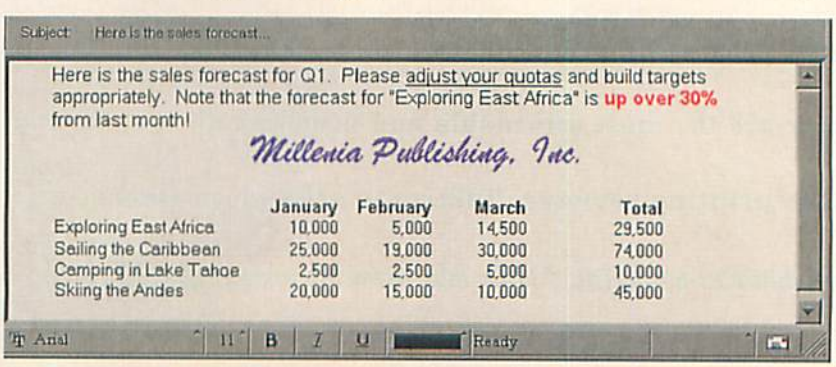
Vendors Ready Better E-Mail Boxes

If you live in e-mail, your house may be about to undergo a major reconstruction. Lotus, Microsoft, SoftArc, and others have renovated their mail client programs to make them more tightly integrated with contact management, scheduling, and other business tasks.

Microsoft's new Outlook program, which will be part of the next version of MS Office, offers a wealth of new features (for more information, see the What's New Software Preview on page 208). And Lotus has similar developments in the works for cc:Mail (see the screen below).

cc:Mail Release 7's new capabilities include basics like the ability to apply styles to individual words in a message. More comprehensive design overhauls include a user interface that more closely resembles that of Notes Mail and tighter synchronization for remote users. The interface for creating rules for handling messages automatically has been improved, and you can test those rules before making them operational. Remote users can access files on the LAN, and new message-sorting capabilities help you tailor your mailbox interface.

SoftArc's FirstClass 4.0 (slated to ship in early 1997) will integrate new calendaring features with its e-mail, collaboration, and other capabilities. Further in the future, expect closer integration of e-mail and telephony, SoftArc officials say. **–DA**



The new cc:Mail finally lets you apply styles to individual words.

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Blasts from the Past

5 Years ago in BYTE

Desqview/X from Quarterdeck finally brought the X Window System to DOS, to tepid response from the market. Microsoft admitted that NT wouldn't support OS/2. Bill Gates said sales of special Presentation Manager versions of Excel and Word were dismal. Meanwhile, Lotus released the first version of 1-2-3 for Windows and the Mac. Lotus later turned its back on the Mac version. And rifts started appearing in the Advanced Computing Environment when it turned out you really would need at least two versions of source code and four compilers. Meanwhile, Compaq's new systems promised Plug and Play, but not *The* Plug and Play. Compaq's version mostly promised that you'd be able to upgrade the processor.

10 Years ago in BYTE

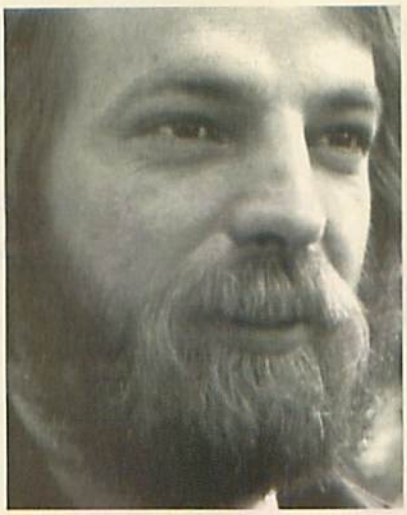
The Apple II GS received mixed reviews. We liked its new 16-bit processor but worried that the GS cost too much and didn't offer graphics superior to the Amiga or Atari. Also, we wondered why Apple would invest such energy in preserving 10-year-old technology.

15 Years ago in BYTE

In their first good look at the brand new IBM PC, BYTE's editors were impressed and even surprised that Big Blue, known then for its big iron, could do such a swell job on a PC. We also ran a long tutorial on an up-and-coming new technology for PCs known as the local-area network.

A Dark Cloud of Bugs

Bruce Brown, president of BugNet, discusses beta software, the proliferation of bugs, and their threat to the industry.



BYTE: How did you decide to get into the bug-reporting business?

Brown: About two years ago, I had a sense that compatibility, glitches, and bugs were going to become an increasing concern to PC users. It seemed clear to me that the bowl of jelly was going to shake when Windows 95 and Windows NT 4.0 hit. I felt this was going to create a need for products and services that would help users get over, or around, these problems. At the outset, we were doing a traditional newsletter, but the newsletter is now 100 percent electronic on the Web. We also sell a database of bug/fixes in HTML, and are syndicated in a half dozen major dailies, as well as InfoWorld and Computer Currents. We also just signed an exciting new mass marketing deal with Online Interactive.

BYTE: With all the free beta software available today, do you feel that people are more willing to put up with bugs?

Brown: That's a complex question which has to be addressed from a couple of angles. Because of the need to generate revenue and sustain stock prices, there is a lot of pressure to release product as quickly as possible and to deal with bugs later. This is a fact of the business and, if anything, is becoming more prevalent, even though vendors obviously don't want to put out products which are so buggy that they depress sales. Beta is a little different, but it also plays into the software vendors' almost maniacal desire to curtail support costs. Beta looks like a dream come true to the vendors because they can say up front, "We're not going to support this," and at the same time they derive certain testing benefits from people who use a beta product and inform the company of problems.

BYTE: Why then is beta a threat?

Brown: The threat is that installing beta can screw something else up in your system. For example, in a bug that BugNet broke, it was revealed that Internet Explorer 3.0 Beta 2 running under Windows 95 replaces one or more system files with versions that are incompatible with some commercial products that you pay money for. So you install the beta and, all of a sudden, some commercial products don't work as they should. And you go to the vendor you paid money to, and now the vendor may very well say to you, "This is a beta, and we don't support beta. You're on your own." Users don't realize that the "free" program that they download may in fact cost them a lot of time and money.

BYTE: Do you think this will change?

Brown: This gets into an issue that I think is really societal. We have come into a situation where the expectations of the user are changing. There is a conflict between the expectations of the traditional users of PCs, the PC enthusiasts, and the new group, normal people who may not want to spend their weekend screwing around with their printer drivers. To make the PC an everyday appliance, this large new group must be satisfied. But these folks expect the darn thing to work when they turn it on, and of course the PC fails this basic test far too often. And so even though the industry as a whole may be doing a better job in the minds of traditional users, it may be doing worse in the minds of the users that the vendors most want to reach. And this, in turn, may be part of why such a shockingly small percentage of PC sales are made to first-time purchasers.

For more information, see http://www.bugnet.com/~bugnet

PHOTOGRAPH: MARY RANDLETT © 1996

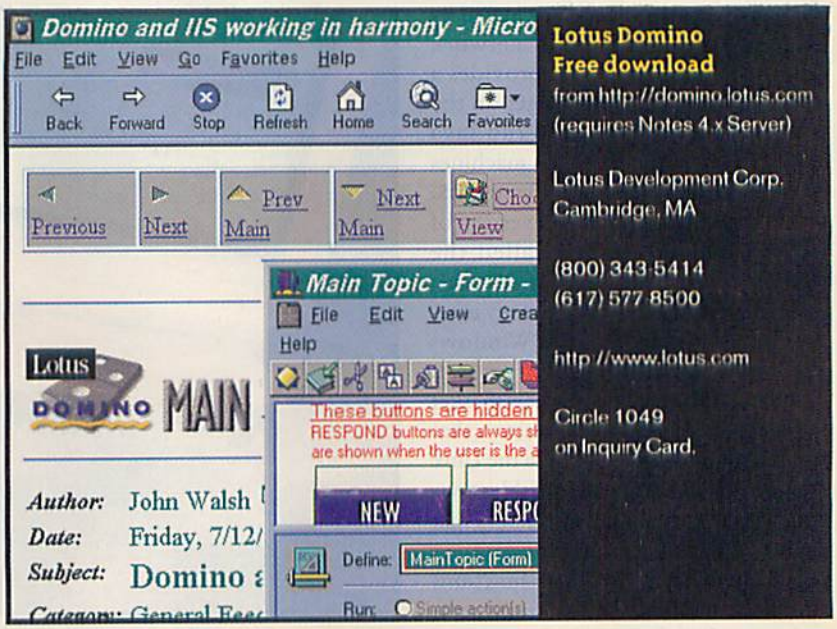
The eagerly awaited Lotus Domino serves up a goodly dose of Notes functionality to Web clients. ***By Steve Gillmor***

Notes Opens Up to the Web

Domino, a.k.a. HTTP Services for Lotus Notes, gives Notes developers a powerful jump-start in creating dynamic Web sites, and it offers unique interactive tools not yet available from other major players. Domino extends Notes' proprietary architecture onto the Web, serving Notes databases to browsers on-the-fly. It loads as a Notes 4.x server task, delivering both a traditional HTTP server and the Domino engine that interacts with the Notes document and object store.

While not eliminating the need for Notes clients, Domino does give Web browsers a great deal of Notes' functionality. Users can browse multiple views; create, edit, and delete documents; perform full-text searches; download binary files; read and send Notes mail; and post documents that trigger work-flow agents.

Installing Domino on our Windows NT server required updating the Notes Release 4.1 Public Address Book and registering Web users, adding them to a special Domino Users group. You can give group members access to databases at a variety of Notes security levels. You can also create an Anonymous entry in the Notes Access Control List to give access to unregistered users.



Domino lets you customize Notes templates, databases, and forms for interactive HTTP serving.

Domino allows Web developers to leverage Notes tools such as input validation and translation formulas, hiding and revealing information based on time-sensitive and user-identity criteria, and displaying threaded discussions that are automatically indexed for querying. The "gold" release we tested supplied several sample databases, including a registration application with several agents.

With Domino, you can detect the type of client and optimize the look of a database according to whether a Web browser or a Notes client is viewing it. Domino supports the insertion of Hypertext Markup Language (HTML) code, combining HTML and Notes data and passing it to the browser. You can use HTML pass-through code to process graphics, run Common Gateway Interface (CGI) scripts, and add URL links. Browsers don't support the same rich server connections as Notes clients, so only server-based agents can use LotusScript scripting.

Domino will evolve as Web browsers acquire more capabilities. But even in its first release, this HTTP server add-in propels Notes to the head of its class. B

Steve Gillmor, of Southern Digital, Inc. (Charleston, SC), has extensive experience using and installing Notes. You can reach him at **sgillmor@aol.com**.

TECH FOCUS

Who's on Guard?

Domino creates new security exposures. Even with optional Secure Sockets Layer encryption, there's somewhat less security when accessing the Notes environment via a Web browser. With a standard Notes client, authentication requires an authorized Notes ID in addition to a password.

Domino globally exposes all Notes databases, requiring you to manually disable confidential databases from the Open Database dialog and Catalog lists. For now, Lotus suggests putting Domino databases on a separate server, using Notes replication to update and maintain communication between Internet and intranet.

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

HDS's @workStation is a low-cost box for Web access, Java applets, and Windows. ***By Peter Wayner***

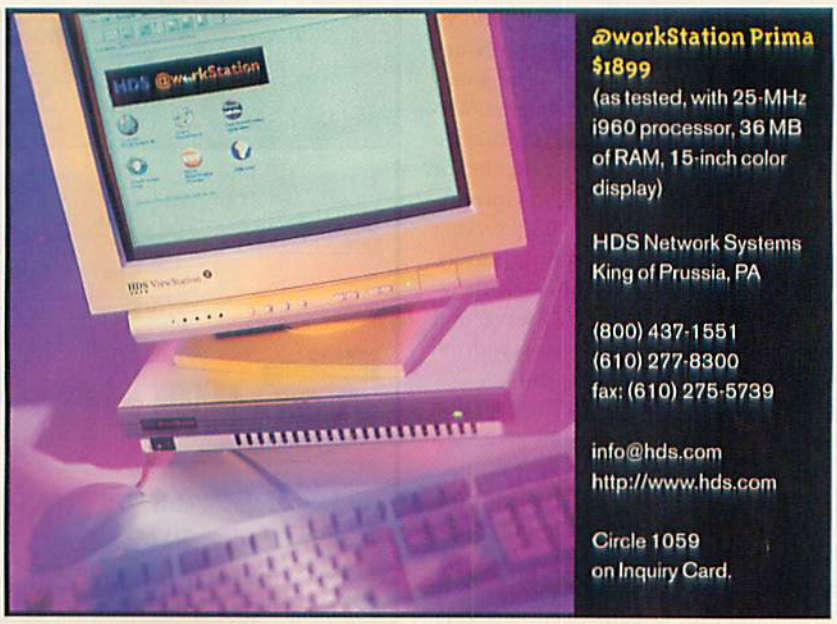
X Terminal + Browser + Java = Web PC

Many people are fascinated by the concept of a "network computer" that provides a low-cost way to get on the Net, browse the Web, and run Java applets. One of the first such machines to reach the market comes from HDS, which is selling an enhanced version of its X Window terminal called the @workStation. The system offers a surprisingly versatile way to give many users access to both the Web and Windows applications for as little as $750 per seat.

HDS could jump into this new market so quickly because smart terminals that run X Window are a fixture in the Unix community. These are often diskless systems with a small amount of memory that simply display whatever the workstation tells them to. HDS took these functions and added three crucial ROM-based components: a Web browser, a Java virtual machine to run applets, and NTRIGUE client software from Insignia Solutions (Santa Clara, CA) that lets you fire up Windows applications remotely. The @workStation provides excellent browsing and Java applet speed because these operations run locally on an Intel i960 embedded RISC machine.

We tested the @workStation Prima, the 25-MHz model. The basic unit ($749) comes with 8 MB of RAM, no hard disk, and a 17-inch grayscale monitor. A system with a 15-inch color monitor costs $1199, while 17-inch color costs $1499. Our test unit—with 36 MB of RAM (128 MB is tops) and a 15-inch color display—priced out at $1899.

The browser firmware, licensed from Spyglass (Champaign, IL), loads documents directly from the Web if you let the @workStation have its own IP address (which can be statically or dynamically assigned). To use Windows applications, however, you must run them remotely on an NT server that's running NTRIGUE ($1995 for five-user license, $195 per additional user). Computation is done on the server machine, but drawing takes place on the @workStation. Sending the drawing information over the network is relatively slow, but not prohibitively so.



The HDS @workStation uses Insignia Solutions' NTRIGUE to access Windows applications on an NT server.

We hooked our test unit through its built-in 10Base-T Ethernet connection to an AST Bravo 200-MHz Pentium Pro system running NTRIGUE. Windows performance on the @workStation was respectable, but the user interface could not duplicate the snappy response of the big machine. For example, when I typed in the NT MS-DOS editor (an old 16-bit application), screen output lagged one or two characters behind. Clearly the network limits the ability for the low-end box to compare with a dedicated PC.

If you're building a network of computers for people who occasionally use Windows applications that are not graphics-heavy, then an array of @workStations could save you money. Hooking up a dozen or so terminals to a good high-end server running NT can cut the cost of hardware and dramatically reduce system upkeep because you have to upgrade only the software on the central NT server. In terms of performance, the @workStation is comparable to that of a PC when using basic applications like word processing. It falls short when running graphics applications like games. But who plays games at work anyway? B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Peter Wayner is a BYTE consulting editor who lives in Baltimore. You can reach him at **pcw@access.digex.net**.

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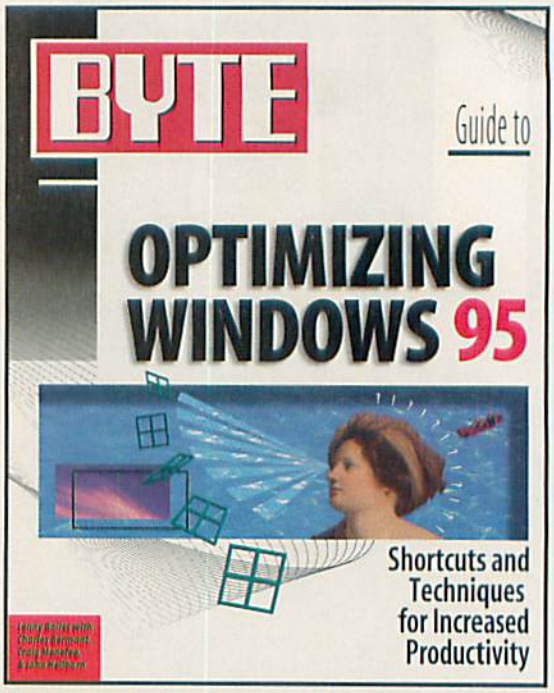

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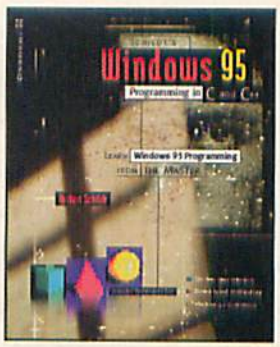

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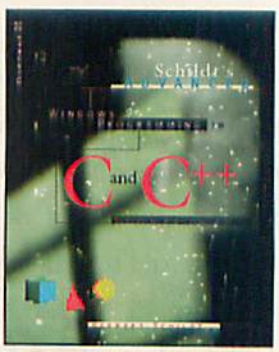

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Innovative optics and integrated Adobe Player firmware make Proxima's new projector a presentation stunner. By G. Armour Van Horn

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After carrying the unit through several airports on a speaking engagement, I have only one complaint: its 27-pound weight. That said, the projector's brightness (350 ANSI lumens), clarity, and flexibility impressed fellow speakers.

The DP4100Z's DLP display engine uses an active semiconductor reflective surface that modulates red, green, and blue images in turn as a tricolor filter rotates through the illumination source (see "Micromirrors Project Better Images," July BYTE). The filter absorbs less light than polarizers, so the image is brighter than images from LCD-based projectors. Because the same addressable matrix forms the three component images, there is no color misregistration.

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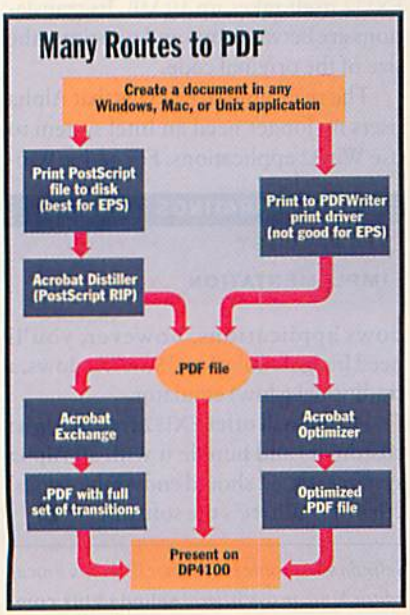
Adobe Acrobat technology turns the DP4100Z into a presentation appliance. DLP optics provide big, bright, razor-sharp images.

The DP4100Z accepts 24-bit video from two computers, has RCA jacks and S-Video inputs for two video sources, and accepts stereo sound from all four. Other connections include a microphone jack, a serial-mouse connector, and outputs for VGA and stereo sound. Its 3-W stereo speakers face backward.

The Media Express option includes Acrobat Exchange PDF editing software (five-user Windows and Mac licenses; Unix is optional), an internal floppy drive to hold PDF presentations, and a plug-in cartridge with a Motorola 68EC040 processor and Acrobat Player firmware to present the slides. Exchange lets you rotate images (a crucial feature), establish transitions between slides (e.g., wipes, window blinds, zooms, and dissolves), crop, set display intervals, and combine different presentations. The cartridge firmware includes limited Exchange capabilities: deleting and sorting slides, adding some transitions, and setting intervals.

The optional Optimizer plug-in compresses PDF presentations. You can fit 1000 slides on a floppy disk. An optional 540-MB hard drive increases capacity.

Equipped with Media Express, the DP4100Z is both a sophisticated presentation system and an "appliance" that requires only the remote control to advance from slide to slide—you can leave your notebook home. Either way, the DLP optical system is superb. B



RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★

G. Armour Van Horn is a production artist and consultant in electronic imaging and prepress. You can reach him at **vanhorn@bix.com.**

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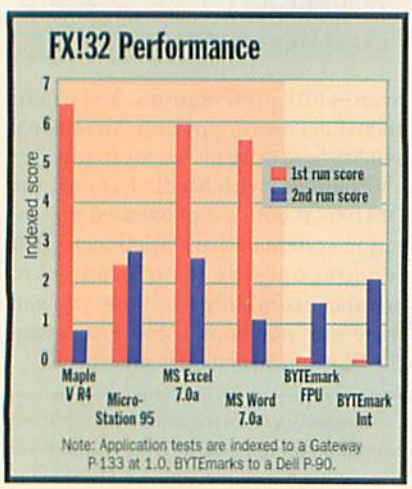
★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

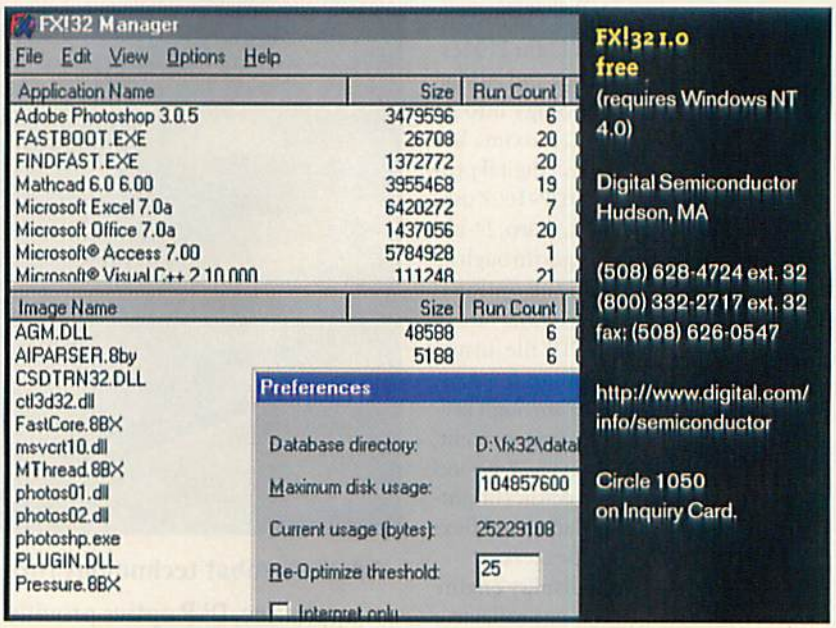
Digital's FX!32 is the key to running Win32 software on Alpha/Windows NT. ***By Selinda Chiquoine***

Alpha Learns to Do Windows

Executing code written for one CPU on another has always been like the talking dog: Though she didn't speak very well, the wonder was that she could do it at all. A new application from Digital Semiconductor has changed the way we think about emulators and what they can do. FX!32 lets you run 32-bit x86 Windows programs on Alpha/NT systems at surprising speeds. Depending on the applications and how they are used, they might run faster on an Alpha system than on a high-end Intel machine, though never as fast as native Alpha programs. In our tests, FX!32 1.0 achieved about 40 percent to 50 percent of the performance of the same code compiled for Alpha.

BYTE editors gave FX!32 the Best Technology award at Comdex last fall because it breaks the emulator mold. It looks at the instructions you're using and translates some of them into native Alpha code, saving the result in a separate DLL. It intercepts system calls and directs them to a native Alpha library. FX!32 thus combines both translation and interpretation, saving execution profiles and analyzing them heuristically (see "An Alpha in PC Clothing," February BYTE).





The FX!32 Manager reports the status of Win32 applications and background code optimization.

I tested FX!32 on a 466-MHz Alpha system with 128 MB of RAM running a beta version of Windows NT 4.0. The BYTEmark test results are summarized in the chart. The FX!32 translations ran at 47 percent (integer) and 32 percent (floating point) of native speeds. Straight emulation clocked at 2 percent to 3 percent.

I also ran scripts using Microsoft Visual Test 4.0, Word 7.0a, Excel 7.0a, Bentley Systems' MicroStation 95, and Maple V release 4. Because FX!32 translates only those parts of an application that you execute, scripts and users that use different commands and system calls will produce different results. Most applications will have a relatively slow first run and increasingly fast second or third run. After that, performance gains taper off.

You can set a maximum disk space allotment for translations, delay optimization, optimize now, delete translated code, or set optimization profile sizes. FX!32 itself takes up 10 MB. Its translations are between one and two times the size of the original code.

The real value of FX!32 is that Alpha users no longer need an Intel system to use Win32 applications. For 16-bit Windows applications, however, you'll need Insignia Solutions' SoftWindows, a traditional (slow) emulator.

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Digital will offer FX!32 free to Alpha customers and bundle it with all Alpha systems. FX!32 should end Alpha critics' cries of, "Where's the software?" B

Selinda Chiquoine is a former BYTE technical editor. You can reach her at **selinda@bix.com.**

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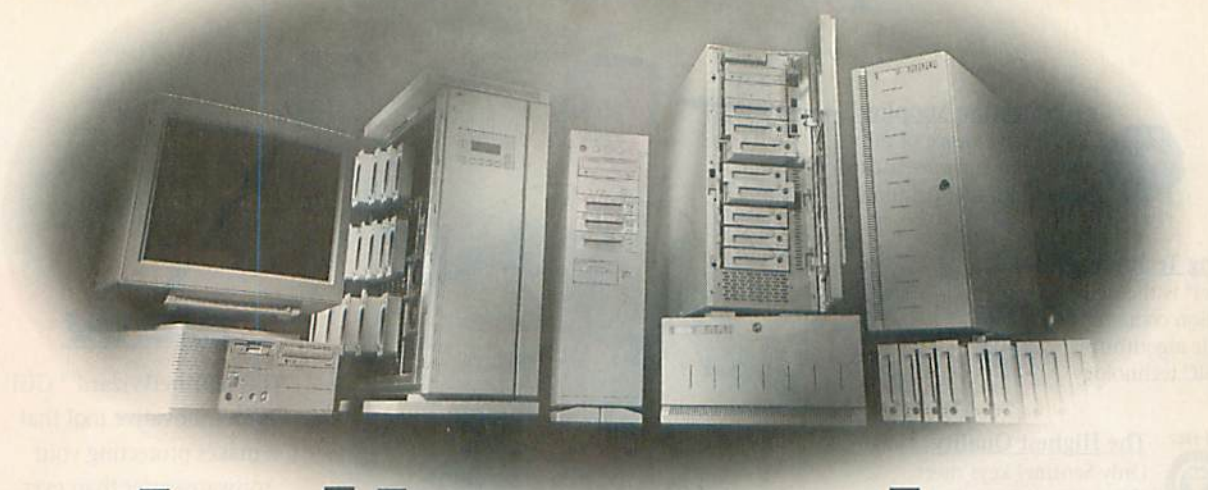

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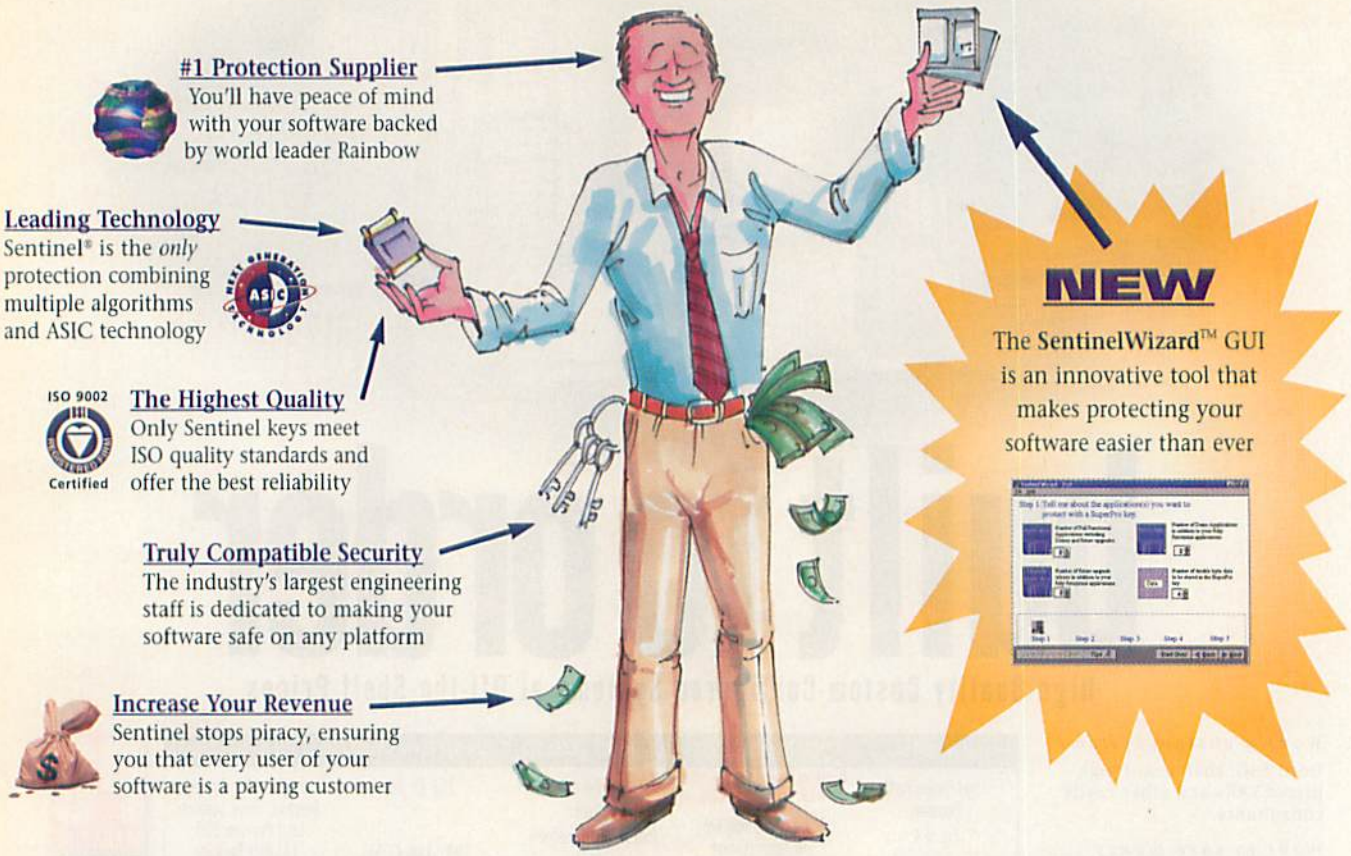

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New Windows 95 features assist computer users who have disabilities. By Joseph J. Lazzaro

Windows 95: Aiding the Disabled

If you run an office staffed with more than 15 employees, you must comply with the Americans with Disabilities Act. This may require that you provide adaptive hardware and software on office workers' computers. Such equipment enables workers with disabilities to accomplish many tasks independently. For example, if you are blind, it can transform on-screen text to synthesized speech or braille. If you can't hear, adaptive hardware transforms a computer's audible cues into a visual format.

So far, adaptive technology has consisted of third-party add-ons to OSes, with the exception of the Mac. This has resulted in adaptive equipment that only sometimes works. Fortunately, because of lobbying by the disabled community, OS vendors have begun to embed adaptive-access features directly into their OSes. This makes such features widely available right out of the box, more reliable, and a lot less expensive.

Microsoft began to build a suite of disability-access features starting with Windows 3.x. Win 95 offers access to a built-in set of utilities that accommodate users with hearing, motor, and some visual disabilities. Furthermore, the Win 95 Help system includes information on these built-in accessibility features.

The control and configuration of most of these features are centralized in an Accessibility Options Control Panel, as shown in the screen at right. This Control Panel lets you activate or deactivate specific access features and customize timings and feedback for certain utilities. It also lets you set hot keys so that you can activate these features quickly.

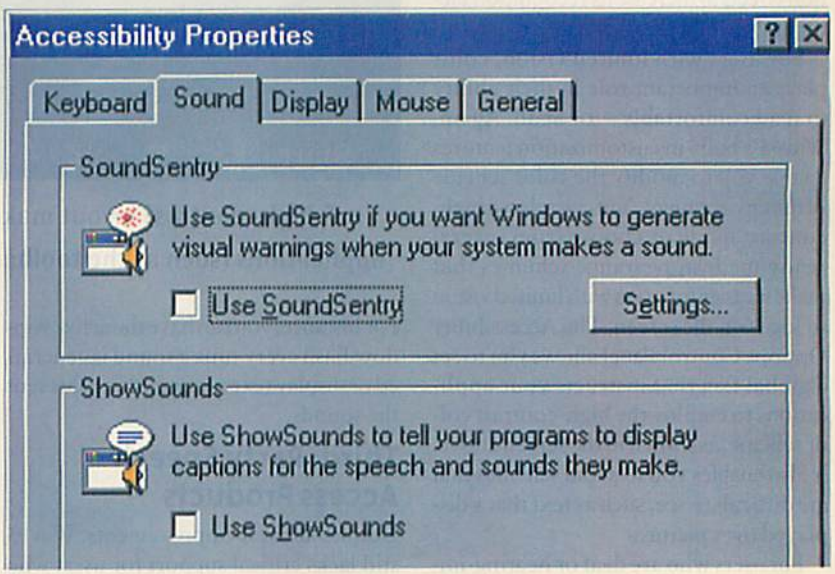
Keyboard and Mouse

Using a keyboard requires a significant amount of hand dexterity, particularly when using the modifier keys, such as Shift, Control, and Alt. For persons unable to use a standard keyboard or mouse easily—if at all—several Win 95 utilities can help by altering the keyboard's behavior. You can configure these utilities in a pane on the Accessibility Options Control Panel.

The StickyKeys utility, for instance, helps you type capital letters or manage complex key sequences, like Control-Alt-Delete, that require the use of both hands. StickyKeys lets you press one key at a time in a sequence instead of pressing multiple keys simultaneously.

Another powerful utility, FilterKeys, helps users who accidentally strike keys by filtering out those keystrokes that do not fall under a user-definable time duration. In other words, for a key press to become a valid keystroke, it must be held down long enough to register. Any keystrokes that don't last for the specified duration are discarded.

ToggleKeys is a utility that provides audio feedback for certain keystrokes. This is a useful tool for computer users who are unable to determine the status of the keyboard's modifier keys by using any other method. The ToggleKeys utility provides both high- and low-pitched beeps that indicate the current status of the Caps Lock, Num Lock, and Scroll Lock keys.



You can configure Win 95 to accommodate users with hearing, motor, and some visual disabilities.

Driving a mouse demands strong hand/eye coordination and good hand/arm agility. It's a prerequisite for using the GUIs on many of today's desktop computers. MouseKeys assists users who have difficulty pointing the rodent. The program lets you use the arrow keys on the keyboard's numeric keypad to move the mouse pointer around the screen and emulate mouse actions, such as clicking, double-clicking, dragging, and dropping. Holding down the Control key accelerates pointer movement, while holding

down the Shift key propels the pointer a pixel at a time, offering fine-grained control.

Video and Sound

For persons who have difficulty seeing images on a standard computer screen, Win 95 offers several features that make the monitor easier to see. Some of these features are simply a matter of adjusting certain Control Panel settings. For example, if you are visually impaired, you can use the Display Panel to scale the size of various user-interface elements, such as window titles, scroll bars, borders, menu text, and icons.

The Mouse Control Panel allows you to adjust the mouse pointer's characteristics. You can select from among several sizes (small, medium, and large), which is valuable for users with limited vision or learning disabilities. You can also adjust the pointer's color and apply animation effects to increase its recognition factor and visibility.

For users with limited vision, color plays an important role in their ability to read comfortably—or at all. Again, Win 95's built-in customization features enable you to modify the color scheme of the environment. You can select a high-contrast mode or choose from several ready-made appearance schemes that make it easier for users with limited vision to focus on the screen. The Accessibility Options Control Panel allows you to set a global flag that instructs your applications to employ the high-contrast color scheme, as shown in the screen above. It also enables you to avoid schemes that are difficult to see, such as text that's displayed over pictures.

For users who are deaf or hearing-impaired, Microsoft has implemented several useful features into Win 95 that increase access to the computer and its data. This is of vital importance as many applications begin to use text-to-speech or audio playback.

Win 95's SoundSentry lets you have sounds presented in an alternative format, such as visually or through text captions. ShowSounds lets you set a global flag that displays sounds in a visual format. This can be accomplished by several methods, depending on your preference. For instance, you can have the active window flash every time a sound is generated or display text captions that represent the sounds.

A high-contrast layout makes for easy reading, but not all applications (such as the toolbar on the left) support this feature.

Third-Party Speech-Access Products

Despite all these improvements, Win 95 still lacks critical support for users who are totally blind and must rely on speech-synthesis systems to read the information on a computer screen. Microsoft plans to implement an off-screen model that captures on-screen information so that special-purpose software can perform a text-to-speech conversion on it or drive a braille-output device.

Unfortunately, the hooks to this mechanism might still be unavailable when this article sees print. This sorry state of affairs presents an opportunity for third-party access technology, chief among them speech- and braille-output packages designed to read the screen.

The Automatic Screen Access program for Windows (ASAW), from MicroTalk, is one of the latest Win 95 screen readers to enter the market. ASAW works with Win 3.x and Win 95 applications. Biolink's ProTalk32 is a screen reader for Win 95. A Win 3.x and NT version is also available. Winvision, from Artic Technologies, runs on both Win 3.x and 95 and supports several commercially available speech synthesizers. Winvision also drives braille displays, providing a tactile representation of Windows screens. Synthavoice's Window Bridge, which runs under Win 3.x, Win 95, and DOS, was the first Windows-based screen reader to enter the adaptive market.

Computers play a major role in our society; they're used at home, at school, and on the job. It only makes sense for OSes to provide adaptive-access features. This makes the computer accessible to everyone, no matter what their abilities, so they can make a contribution in the workplace. Microsoft has done a commendable job so far with much-needed improvements to Win 95. But the company still has a lot of work to do if Windows is going to provide OS-level support for blind computer users. B

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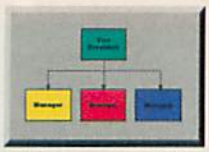
Joseph J. Lazzaro is the author of Adapting PCs for Disabilities *(Addison-Wesley, 1996). He is also project director of the Adaptive Technology Program at the Massachusetts Commission for the Blind in Boston. You can reach him at* **lazzaro@world.std.com** *or at* **lazzaro@bix.com.**



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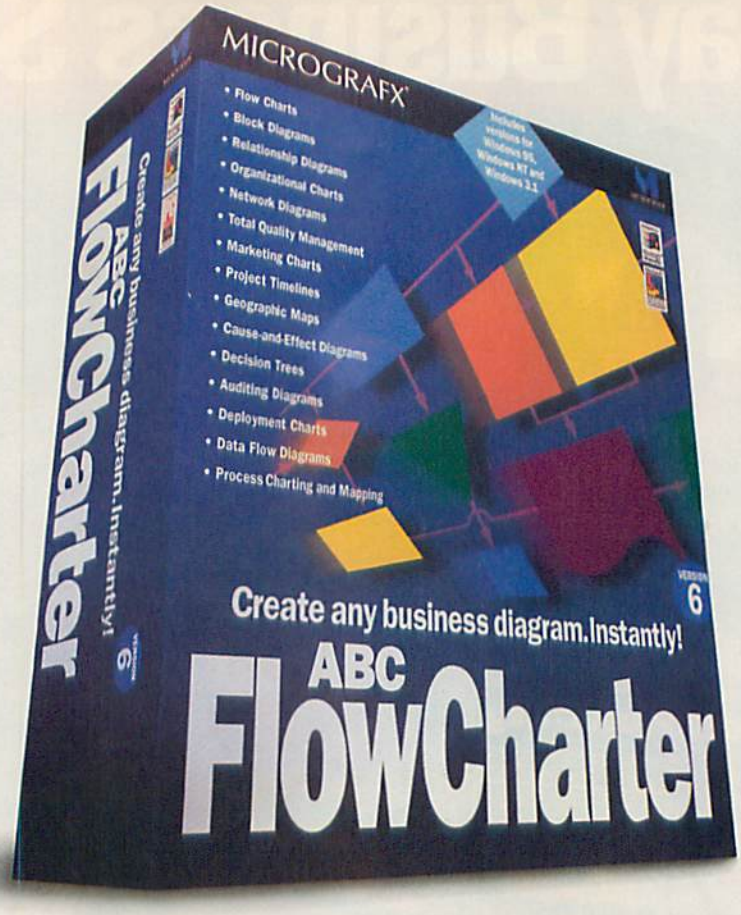

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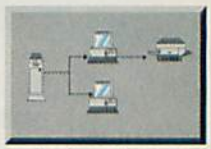

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A look at HTTP version 1.1, a necessary new Internet standard. By William Stallings

The Backbone of the Web

The Hypertext Transfer Protocol is the foundation protocol of the World Wide Web. The name is somewhat misleading. HTTP is not a protocol for transferring hypertext; it is a protocol for transmitting information with the efficiency necessary to make hypertext jumps. The data transferred by the protocol can be plain text, hypertext, audio, images, or any Internet-accessible information. Information in this article is based on the most recent (June 7, 1996) specification—HTTP 1.1, draft 05—which has been forwarded to the Internet Engineering Standards Group as a proposed standard.

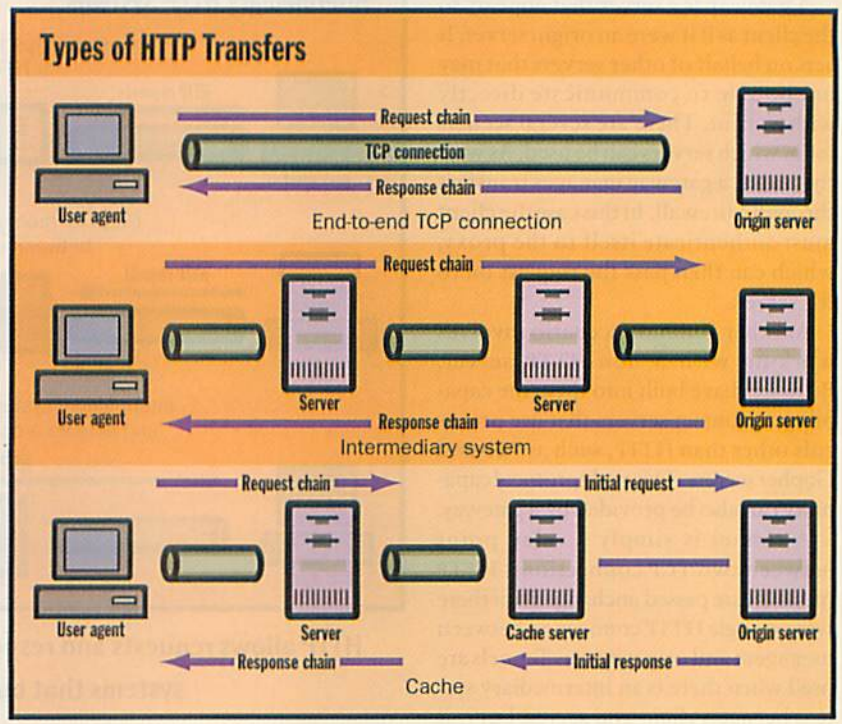
HTTP is a transaction-oriented client/server protocol. To ensure reliability, HTTP uses TCP. Nevertheless, HTTP is a "stateless" protocol: It treats each transaction independently. A typical implementation will create a new TCP connection between client and server for each transaction, then terminate the connection as soon as the transaction completes. However, the specification does not require this one-to-one relationship between transaction and connection lifetimes; i.e., the connection can stay open so that more transactions can be made.

The stateless nature of HTTP is well-suited to its typical application. A normal Web session involves retrieving a sequence of pages and documents. The sequence is, ideally, performed rapidly, and the locations of the various pages and documents may be widely distributed among a number of servers, located across the country or around the globe.

The figure "Types of HTTP Transfers" illustrates three examples of HTTP operations. The user agent is the client, such as a Web browser, that initiates the request. The origin server is the server on which a resource resides; an example is a Web server where a desired home page is located. The simplest case is one in which a user agent establishes a direct connection with an origin server. The client opens a TCP connection that is end-to-end between the client and the server. The client then issues an HTTP request. The request consists of a specific command (referred to as *a method*), a URL, and a message containing request parameters, information about the client, and perhaps additional content information.

When the server receives the request, it attempts to perform the requested action and then returns an HTTP response. The response includes status information, a success/error code, and a message containing information about the server, information about the response itself, and possible body content. The TCP connection is then closed.

The middle section of the figure shows a case in which there is not an end-to-end TCP connection between the user agent and the origin server. Instead, there are one or more intermediary systems with TCP connections between logically adjacent systems. Each intermediary system acts as a relay, so that a request initiated by the client is relayed through the intermediary systems to the server, and the response from the server is relayed back to the client.



HTTP supports operations via direct connection, intermediary systems, or a cache.

The Machine in the Middle

The HTTP spec defines three forms of intermediary systems: proxy, gateway,

and tunnel (see the figure "Intermediary HTTP Systems"). A proxy acts on behalf of other clients and presents requests from other clients to a server. There are several scenarios that call for the use of a proxy. In one scenario, the proxy acts as an intermediary through a firewall. In this case, the server must authenticate itself to the firewall to set up a connection with the proxy. The proxy accepts responses after they have passed through the firewall. Another scenario involves handling different versions of HTTP. If the client and the server are running different versions of HTTP, then the proxy can implement both versions and perform the required mapping.

A gateway is a server that appears to the client as if it were an origin server. It acts on behalf of other servers that may not be able to communicate directly with a client. There are several scenarios in which servers can be used. As with the proxy, a gateway manages transfers through a firewall. In this case the client must authenticate itself to the proxy, which can then pass the request on to the server.

Another common scenario involves working with a non-HTTP server. Browsers have built into them the capability to contact servers that use protocols other than HTTP, such as FTP and Gopher servers. This multiprotocol capability can also be provided by a gateway.

A tunnel is simply a relay point between two TCP connections. HTTP messages are passed unchanged as if there were a single HTTP connection between user agent and origin server. Tunnels are used when there is an intermediary system between client and server, but it is not necessary for that system to understand the contents of messages.

Now let's take a look at another type of HTTP operation. A cache is a facility that stores previous requests and responses for handling new requests. If a new request arrives that uses the same stored request, then the cache can supply the stored response rather than access the resource indicated in the URL. The cache can operate on a client or on a server or on an intermediary system other than a tunnel. In the figure "Types of HTTP Transfers," a server has cached a request/response transaction, so a corresponding new request from the client need not travel the entire chain to the origin server; instead, the cache server handles it. Not all transactions can be cached, and a client or a server can dictate that a certain transaction may be cached only for a given amount of time.

HTTP Messages

HTTP messages comprise two types: request and response. A request message is sent by an agent to a server to initiate some action. A response message is returned by a server to an agent in response to a request. Some possible actions are:

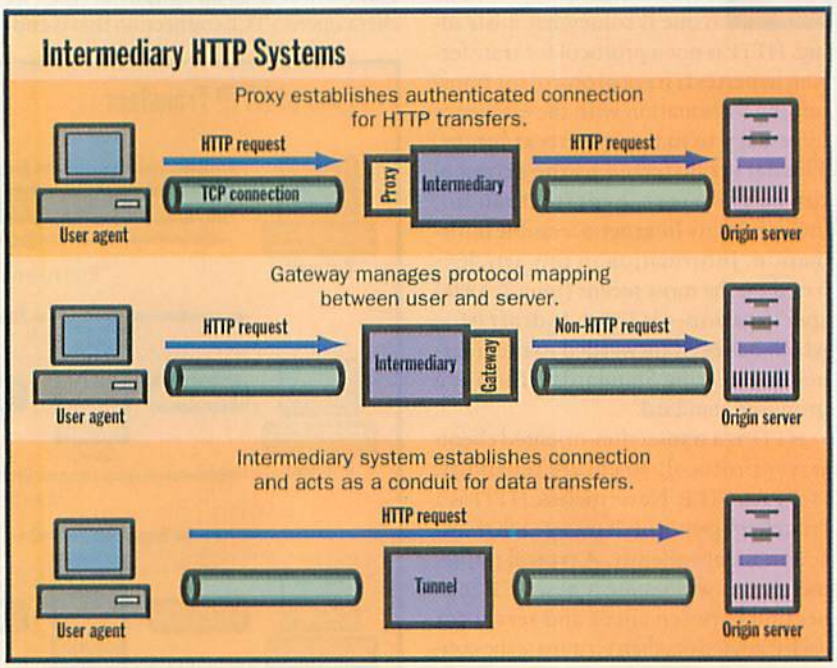
- GET: A request to retrieve information.
- POST: A request to accept the attached entity as a new subordinate to the identified URL.
- PUT: A request to accept the attached entity and store it under the supplied URL. This may be a new resource with a new URL, or it may be a replacement of the contents of an existing resource with an existing URL.
- DELETE: Requests that the origin server delete a resource.

A response message may include an entity body containing hypertext-based information. In addition, the response message must specify a status code, which indicates the action taken on the corresponding request. Status codes are organized into the following categories:

- Informational: The request has been received and processing continues. No entity body accompanies this response.
- Successful: The request was successfully received, understood, and accepted.
- Redirection: Further action is required to complete the request.
- Client error: Request contains a syntax error or request cannot be fulfilled.
- Server error: The server failed to fulfill an apparently valid request.

We Need This Standard

HTTP is the foundation of the World Wide Web. This request/response protocol used on top of TCP carries commands from browsers to servers and responses from servers back to browsers. As the explosive growth of the Web continues, and as new features are added to both browsers and servers, a standardized transfer protocol is essential to maintain the Web's growing functions and interoperability. HTTP provides the standardized definition required to meet these needs. B



HTTP allows requests and responses to pass through disparate systems that build the network.

William Stallings is a consultant and author of over a dozen books on data communications and networking. This article is based on material from his most recent book, Data and Computer Communications *(Prentice-Hall, 1996). You can reach him at* **ws@shore.net**.

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RISC powers Intel's intelligent I/O controller for servers. ***By Tom Thompson***

The Server's Helper

The changing nature of information that office workers use has had an impact on the role the network server plays. Today's server must pump out digital video, audio, and 3-D graphics on demand; handle complex database queries; and manage Web transactions. As a consequence, a server requires a more efficient architecture than just a souped-up desktop-computer design. A faster processor and system bus aren't enough. The computer must manage the vast amounts of I/O this type of data demands. Radical architectures from Tandem and Sequent address this problem on high-end server designs, as described in "The Network in the Server" (July BYTE).

Moderate-size servers must also work with the same type of data, on a smaller scale. When it comes to handling I/O, such servers must work smarter, not harder. Even a multiprocessor server can grind to a halt if each processor is supervising a peripheral or—worse—waiting to access a congested system bus.

To this end, Intel just started sampling the i960 RP, a 32-bit RISC processor that functions as an intelligent I/O controller. It supports DMA transfers, address translation, various memory types, and multiprocessor interrupt control. Thus, it can manage most of a server's peripheral I/O traffic without CPU intervention, eliminating many throughput bottlenecks.

The i960 RP also acts as a PCI-to-PCI bridge unit, which lets you add more slots to the design. At the same time, the bridge unit reduces the number of components required to build a server that uses state-of-the-art high-speed PCI peripherals. This enables a server to provide high throughput yet remain affordable.

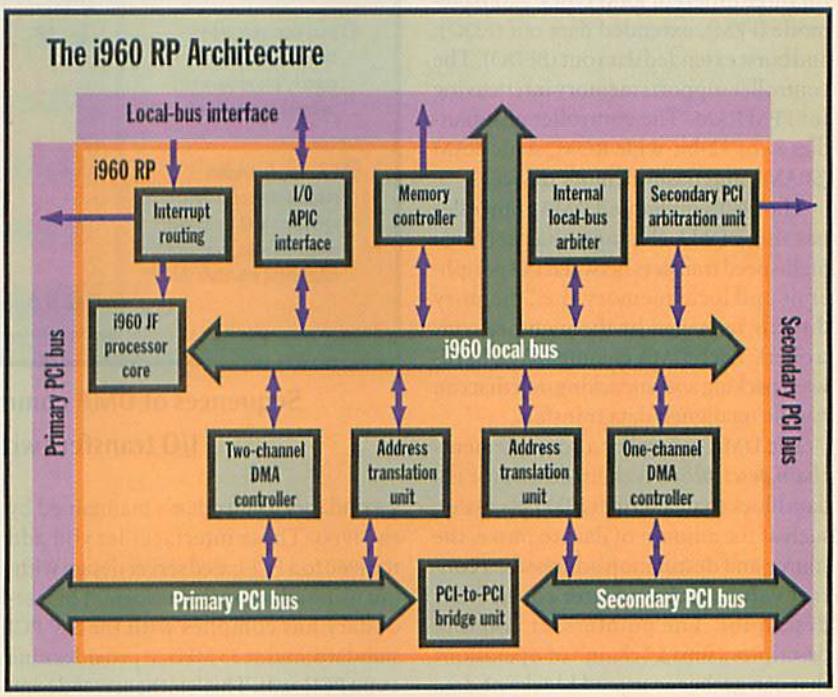
RISC at the Core

Like other chip vendors' smart I/O processors, Intel took the core of its tried-and-true i960 JF embedded processor and wrapped I/O support logic around it. Our tour of the processor begins with this RISC core. The i960 JF core consists of 32 32-bit registers. Sixteen of them are local (general-purpose); the other sixteen are global registers used for parameter passing or storing critical variables. An on-chip local-register cache stores up to eight copies of the local registers. This provides hardware support for the rapid entry and exit of function calls, a useful feature for time-critical interrupt handlers.

The core consists of 700,000 transistors and has a four-stage pipeline. It has several independent execution units (EUs): one for instruction processing and address generation, a multiply-divide-unit (MDU) for 32-bit math computations, and a memory interface unit that handles load/store operations. The core can scoreboard individual registers, so the processor can execute certain instructions in parallel, or out of order, to maintain single-cycle instruction execution.

The core includes a 4-KB two-way set-associative instruction cache, a 1-KB direct-mapped data cache, and 1 KB of on-chip data RAM. You can enhance interrupt processing by *locking* sections of interrupt-handler code within the instruction cache and by storing a number of interrupt vectors in the on-chip memory. At 33 MHz, the core delivers 31 VAX MIPS.

A bus-control unit (BCU) supports 8-, 16-, and 32-bit memory addressing, plus big-endian and little-endian addressing



This intelligent I/O controller manages DMA transfers and memory timing. It also acts as a PCI-to-PCI bridge.

modes. This lets the i960 connect to a large variety of memory and peripherals. Up to eight sections of memory, each 512 MB in length, can be defined with different memory-width attributes. Regions of memory ranging in size from 4 KB to 4 GB can also be defined as cacheable (typically for program memory) and noncacheable (typically for I/O devices).

Device Interfaces

The i960 RP provides a wealth of device interfaces and control functions, such as a memory controller, DMA controller, and PCI-to-PCI bridge unit, as shown in the figure "The i960 RP Architecture." These features can be used to both simplify a server design and improve system throughput.

The built-in memory controller generates the appropriate timing and signals for three different RAM types: fast page-mode (FPM), extended data out (EDO), and burst extended data out (BEDO). The controller supports memory interleaving for FPM RAM. The controller also handles 8- or 32-bit-wide ROM, static-RAM (SRAM), and flash-memory devices.

The i960's integrated DMA controller has three DMA channels that perform high-speed transfers between PCI peripherals and local memory (i.e., memory directly managed by the memory controller). Each DMA channel has a hardware packing and unpacking unit that can handle unaligned data transfers.

The DMA controller also implements *chain descriptors*. A chain descriptor is a data block that describes a DMA transfer, such as the amount of data to move, the source and destination addresses, a control value, and a pointer to the next descriptor. The pointers let you link descriptors into a "chain" of operations that can gather scattered blocks of data and transfer them in one chunk to the destination. These chains can implement sophisticated data transfers, perhaps moving data from a hard drive into memory and then to a network device, as shown in the figure "An Intelligent I/O Operation." Such a chain can supervise this type of complex transfer without interrupting the host processor, unless an error occurs.

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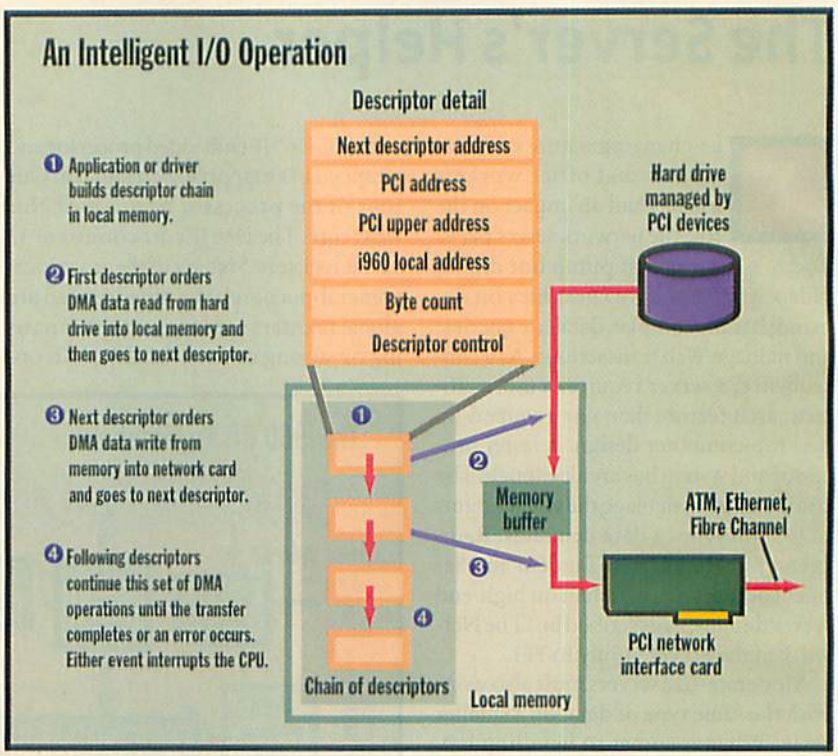
A Built-In Bridge

The most versatile feature of the i960 RP is its PCI-to-PCI bridging capability. It supports two PCI buses: a primary PCI bus, which connects to the host CPU, and a secondary PCI bus that's maintained by the i960. These interfaces let you add the i960 to a PCI-based server design without using additional glue logic. This secondary bus complies with the 5-V PCI standard, and at 33 MHz, it provides nine extra PCI loads. This lets the server design offer more PCI devices or card slots. You can attach additional i960 RP processors to the secondary bus to build a hierarchy of PCI buses, so that the system can handle a large number of network interfaces and storage devices.

The i960's PCI bridge logic can forward memory, I/O, and command transfers between the two PCI buses. However, you can program the bridge logic to "filter" certain PCI transactions. This reduces traffic in other buses on the server and aids in the implementation of intelligent I/O subsystems. For example, suppose a hard drive is streaming video data to an Ethernet interface, and both these PCI-based devices reside on the PCI secondary bus. The bridge logic blocks these transfers from the primary PCI bus, so that it can independently handle a different set of I/O operations.

The DMA controller works in tandem with the PCI-to-PCI bridge unit to boost throughput. Also, properly written descriptor chains can add smarts to low-cost PCI peripherals, so that their use improves performance while minimizing CPU overhead.

As you can see, the i960 RP offers many capabilities to a server design. Certain functions, such as the DMA controller, allow the systems designer to hand off data transfers between memory and peripherals to the i960, thus relieving the server's CPUs of this chore. Other functions, such as the memory controller and the PCI-to-PCI bridging capability, allow the engineer to eliminate some parts from the design, thus reducing the server's cost and complexity. B



Sequences of DMA commands can manage complex I/O transfers without CPU support.

Tom Thompson is a BYTE senior technical editor at large. He has a B.S.E.E. degree from the University of Memphis. You can reach him on the Internet at **tom_thompson@bix.com**.

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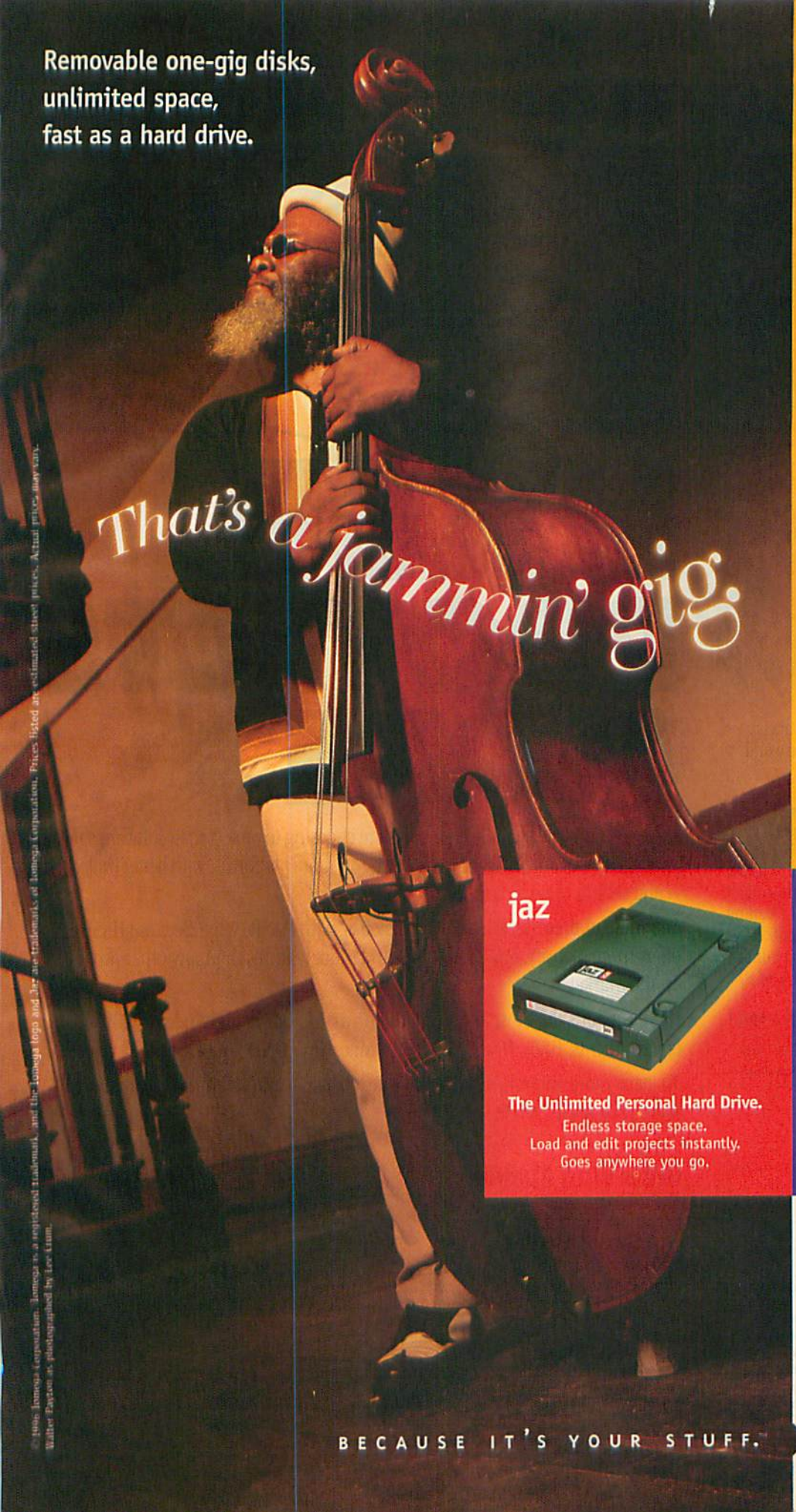

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Add an interactive database to your Web pages with a few simple tools. By Rick Dobson

Make Access and the Web Work Together

Perhaps you've seen one of those cool Web pages where you type in a request to obtain up-to-the-minute product information. Microsoft's Internet Information Server (IIS), with its Internet Database Connector (IDC), simplifies the process of building dynamic Hypertext Markup Language (HTML) pages so that you can add such a mechanism into your Web pages. This lets you develop and maintain intranet and Internet Web sites that allow the interactive search, display, and modification of information in a Microsoft Access database.

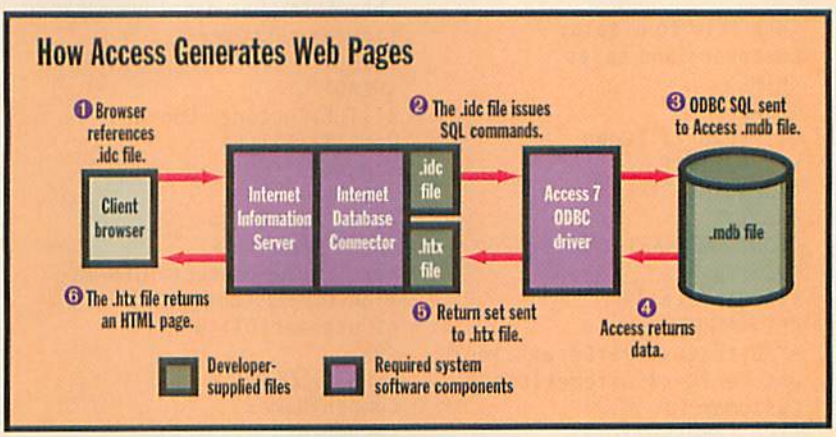
It's important to note that such applications can support only low to intermediate hit rates. However, it's easy to upsize them to full-blown SQL Server applications. Thus, Access shines as a rapid prototyping tool for building frequently visited Internet sites.

This approach requires three items. First, Web-site visitors must have Web browsers. Second, the IIS/IDC must be running on the server. The IDC is a DLL named HTTPODBC.DLL. Third, you must install the Access 7 for Windows 95 Open Database Connectivity (ODBC) driver on the server. The IDC requires such a "thread-safe" ODBC driver so that multiple clients can launch concurrent queries against the same data source.

Dynamic Access Parts

The Web browser handles any user events and typed input, and it displays the information returned by the database. An .mdb file stores the tables, forms, queries, and modules that comprise your Access database. Two key developer-designed files on the IIS manage the interactive process, as shown in the figure "How Access Generates Web Pages." The .idc file defines specific valid data fields and operations; the .htx file formats the returned data for display by the client browser.

The key field in an .idc file is `SQLStatement`. It lets you perform all the functions permitted by Access's SQL. Two other required fields are `Datasource` and `Template`. `Datasource` ultimately points the query embedded in `SQLStatement` to the appropriate .mdb file. Finally, `Template` names the .htx file that's responsible for formatting the result.



The developer provides several files to create an interactive database connection on the Web.

You can include several optional fields that refine your application's behavior. `MaxRecords` designates the maximum number of records a query returns. With `DefaultParameters`, you can supply default criteria for a query when the client fails to do so. Use `RequiredParameters` instead to generate an error when the client browser does not provide a parameter. `Username` and `Password` act as a gateway to security features. These fields, in conjunction with Access's users, groups, and permissions features, can restrict admittance to tables with sensitive data, such as salaries.

The .htx file is a template for the HTML file passed back to the client Web browser from the IIS. The .htx file includes special tags for processing the query results returned by the ODBC driver. These vendor-specific tags, in conjunction with traditional HTML tags, let developers control what a client browser views.

A Sample Program

I constructed a simple database application based on the Northwind database sample that ships with Access. My test database includes two tables. The first, `tblCustomers`, contains the `CustomerID`, `CompanyName`, `ContactName`, and `Phone` fields. The second, `tblSalesByCustomer`, houses the `CustomerID` and `Sum` fields. `Sum` contains the total sales for each customer.

My initial .idc file (shown in the listing "Query Input and Control" on page 72) creates a listing of the top 10 customers ranked by sales in descending order. This file contains four fields. The first one, `Datasource`, points to the target .mdb file, as routed through an ODBC data source. The ODBC-driver dialog box has a New button that allows the developer to create the data source that points to the .mdb file. However, `Datasource`

eliminates this bit of manual intervention for the user, which is necessary to support a self-contained Web site.

The second field, `Template`, names an .htx file that serves as a template for formatting the HTML page to appear on the client's browser. The third field, `MaxRecords`, restricts the lists of returned records to 10. Finally, `SQLStatement` includes the SQL string that controls the query. Each line, including the first one, must begin with a plus sign.

An .htx file can contain all the graphic files and formatting touches that regularly adorn the HTML pages at your favorite Web sites. The .htx file displays the query results within a pair of `<%BeginDetail%>` and `<%EndDetail%>` vendor-specific tags. To display a particular query, bracket its name inside these vendor-specific tags (e.g., `<%Sum%>`). The IIS repeatedly merges all .idc fields between `<%BeginDetail%>` and `<%EndDetail%>` for each record in the return data set.

You create drill-down hyperlinks to other pages by use of HTML anchor tags. You do this by placing another .idc filename between the anchor tags, which in turn creates a drill-down page. A question mark must follow the .idc filename. This is demonstrated in the first listing's .htx file. When you need to pass a parameter to the second .idc file, insert a phrase such as `CustomerID=<%CustomerID%>` after the .idc filename. The left term, `CustomerID`, designates a field in `SQLStatement` for the second .idc file. The term that's on the right of the equal sign references the value in the current hyperlink.

The listing "Data Close Up" shows the .idc and .htx files that generate the drill-down page from the top 10 `CustomerID` displays. This .idc file extracts the company and contact names along with the phone number for the `CustomerID` that matches the one in the hyperlink jump. It accepts a passed argument with an expression such as `CustomerID=%CustomerID%` in the `Where` clause of its `SQLStatement`. The term on the left of the equal sign corresponds to a field in the `Select` list of the query. The term on the right of the equal sign represents the passed parameter. Its value is set by the calling hyperlink jump.

The .htx file in the listing "Data Close Up" demonstrates some basic HTML tag techniques for controlling the display of records returned by an .idc file. Its corresponding .idc file returns a single record with four fields. The `BR` tag positions each field on a different line. The other tags adjust the font and the position of the results.

Query Input and Control

```
.idc file that shows top 10
customers
Datasource: WebSales
Template:
SalesByCustomer.htx
MaxRecords: 10
SQLStatement:
+ SELECT CustomerID, Sum
+ FROM tblSalesByCustomer
+ ORDER BY Sum DESC

.htx file to display
customers and sales
<HTML>
<HEAD>
<TITLE>Drill-Down
List</TITLE>
</HEAD>
<BODY>
<FONT FACE=ARIAL SIZE="2">
<UL>
<%BeginDetail%>
<LI><A HREF
="/Byte/CustomerDetail.idc?C
ustomerID=<%CustomerID%>">
Customer ID:
<%CustomerID%></A>,
<%Sum%><BR>
<%EndDetail%>
</UL>
</BODY>
</FONT>
</HTML>
```

Data Close Up

```
.idc file that drills down to
detail a particular customer
Datasource: WebSales
Template: CustomerDetail.htx
SQLStatement:
+ SELECT CustomerID,
CompanyName,
+ ContactName, Phone
+ FROM tblCustomers
+ Where
CustomerID=%CustomerID%

.htx file that displays a par-
ticular customer
<HTML>
<HEAD>
<TITLE>Customer Contact
Detail</TITLE>
</HEAD>
<BODY>
<%BeginDetail%>
<FONT SIZE="4">
Here is the contact informa-
tion for CustomerID:
<%CustomerID%><BR>
<P>
<FONT SIZE="3">
CompanyName:
<%CompanyName%><BR>
ContactName:
<%ContactName%><BR>
Phone: <%Phone%><BR>
<%EndDetail%>
</BODY>
</FONT>
</HTML>
```

Pairs of .idc/.htx files that implement an Access database query for the top 10 customers and display the results.

Closing Issues

The IIS/IDC plus Access provides a quick, easy way to start publishing dynamic HTML pages from a database. Many more options beyond those in the code listings are feasible. For example, you can populate combo boxes on HTML forms, or you can accept values directly from HTML forms for selecting or updating an Access database.

I found the new functionality easy to use, but experienced Access developers will appreciate enhancements. First, Access developers are used to more flexibility in processing return sets than the .htx file permits. Among the features missing are event programming and expressions. Second, no error-trapping techniques are available with this release. While errors do not cause the system to abruptly halt without user recovery, you can still be confronted with error messages that may not be meaningful. Third, wizards and more graphical development aids would help promote the acceptance of this Web development strategy among Access developers. B

Rick Dobson is president of CAB, Inc., a database and Internet consultancy. You can reach him at **Rick_Dobson@msn.com.**

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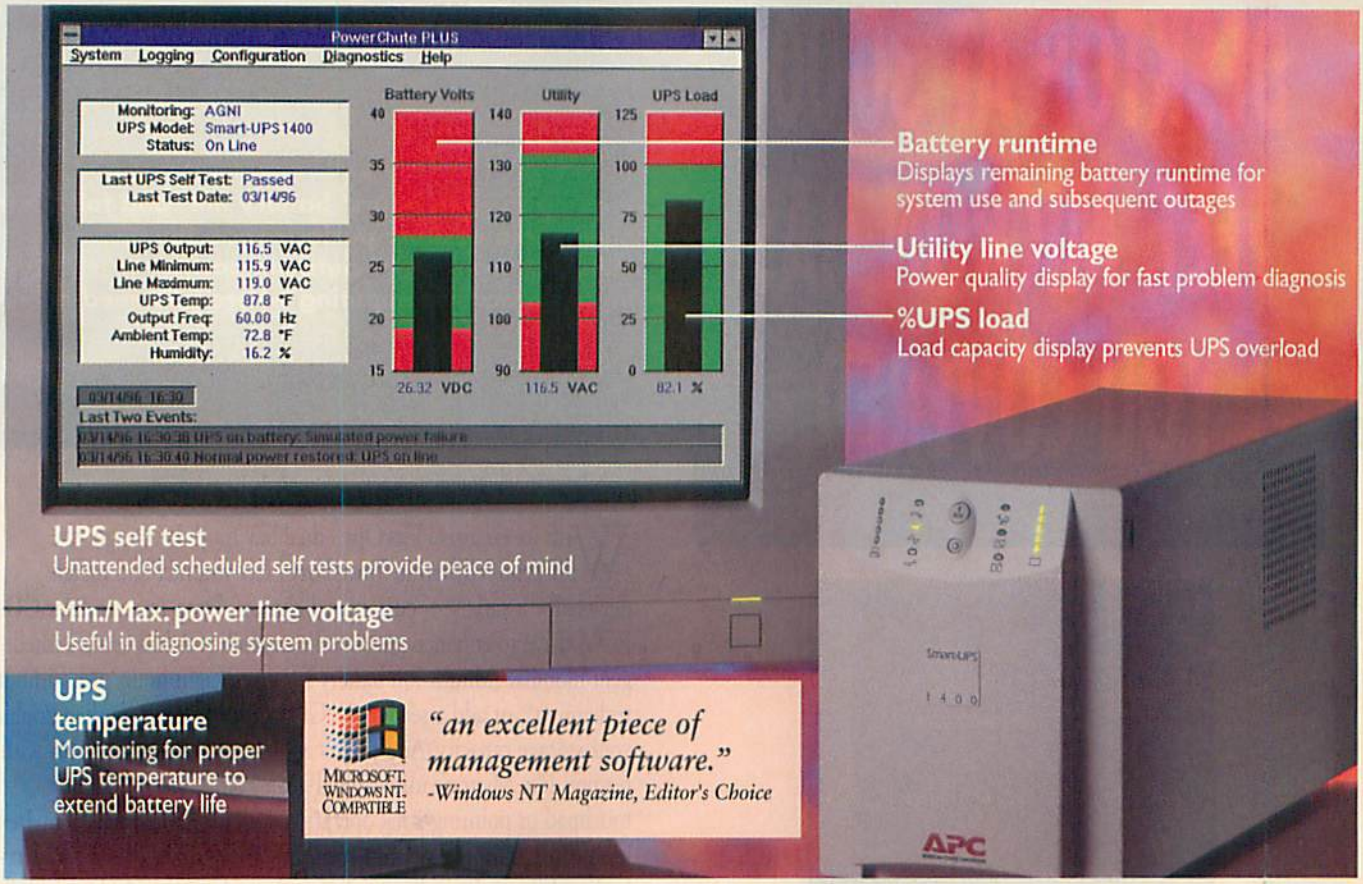

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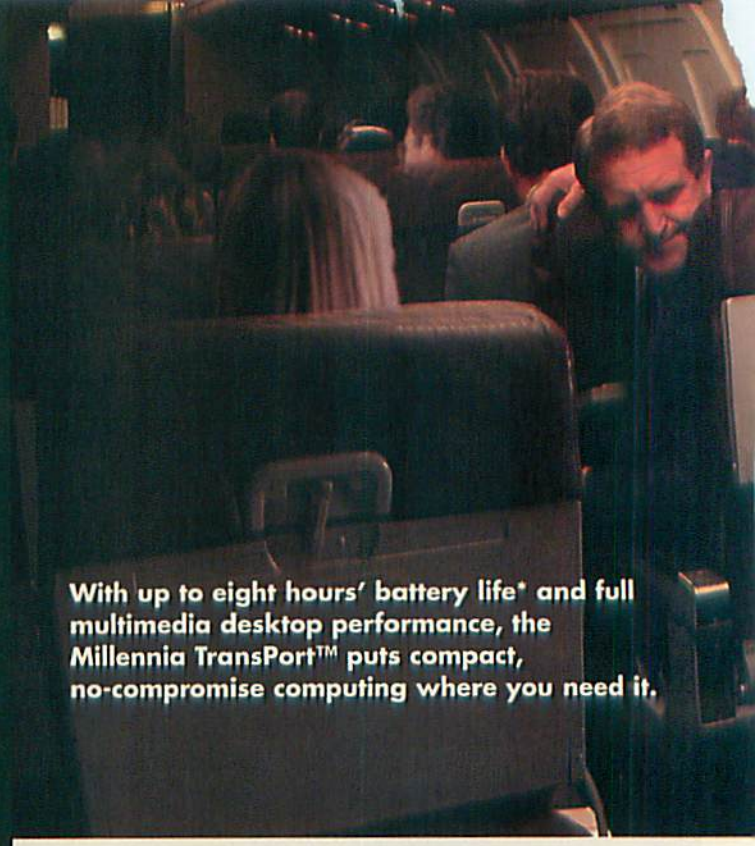

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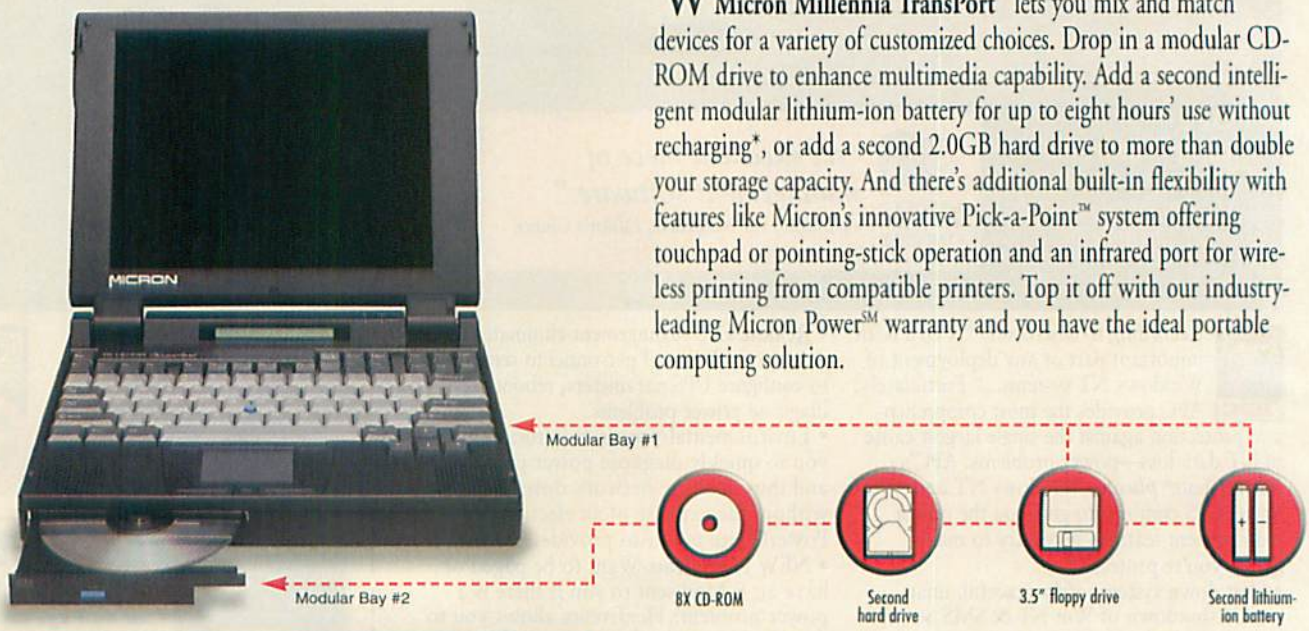

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3-D for EVERYONE

Seeing isn't believing: 3-D must face growing pains before it can become essential for business applications.

By Udo Flohr

Now that low-cost 3-D is reaching our desktops at little or no extra cost, cynics might respond with a resounding, "So what?" They counter that, unless you're hooked on shoot-'em-up games, low-cost 3-D is just another check-off item from board vendors vying for your business.

But proponents counter that 3-D's potential for general-purpose computing is wide open. Just as GUIs and the mouse changed the face of computing during the past decade, 3-D will bring about new ways of viewing and analyzing data.

Timing puts the truth somewhere between these two opposing views. Innovators at places such as Xerox's Palo Alto Research Center (PARC) are already showing early software designs that use 3-D to add layers of information to databases and interfaces, making today's 2-D software look Spartan by comparison. But commercial versions of these products are at least a year or two from widespread use.

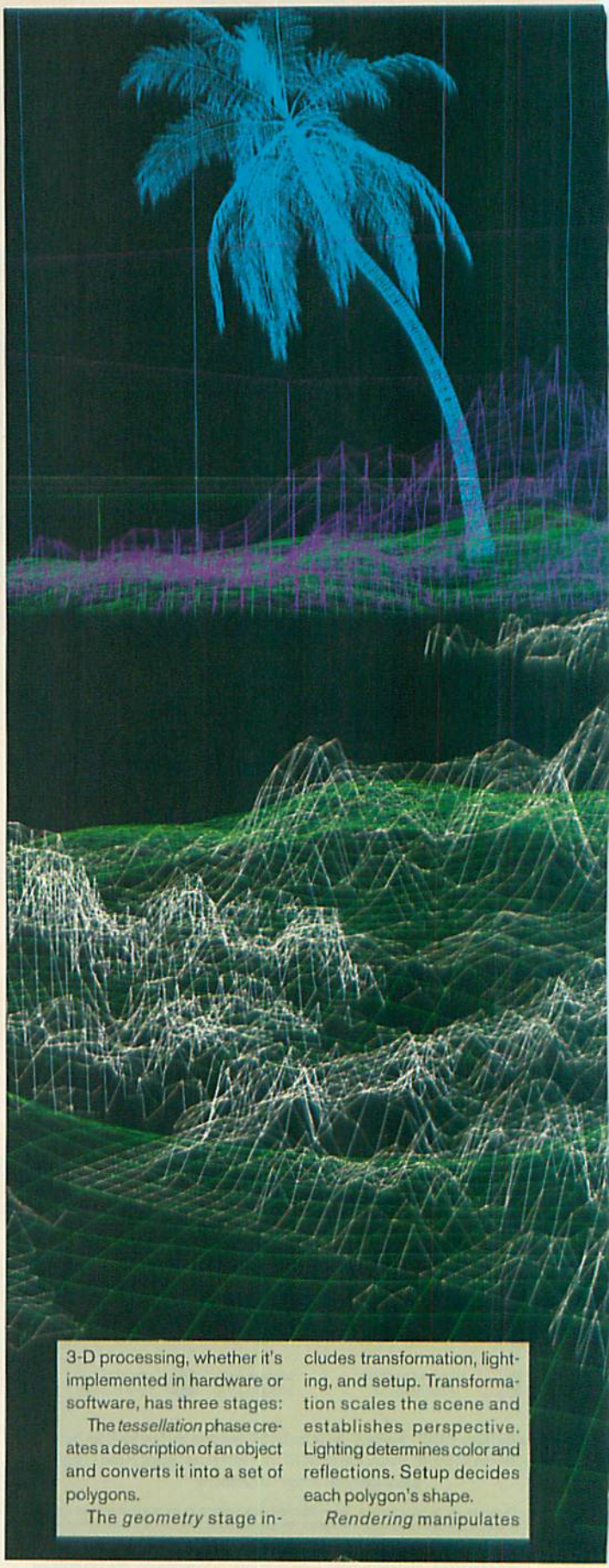
In the meantime, buyers beware: Not all the chips, boards, and APIs that spawned this year's crop of low-cost 3-D products will have the ability to run tomorrow's applications. To keep their designs affordable, vendors of low-end 3-D products made some compromises. As a result, some game-optimized chips cannot provide the processing power that professional-level 3-D accelerators now deliver for simulations and CAD applications.

The bottom line is that today's low-cost 3-D world is neither insignificant nor fully formed. This situation forces us to look beyond the glittering graphics to make judicious choices about 3-D.

Real 3-D

How might 3-D eventually change the way in which we work? The first phase of mass-market 3-D products will bring traditional 3-D applications, such as architectural walk-throughs, virtual reality, animation, and state-of-the-art games, to mainstream desktops. Next we'll see 3-D applied to standard applications, such as graphics editors, spreadsheets, and even word processors.

continued

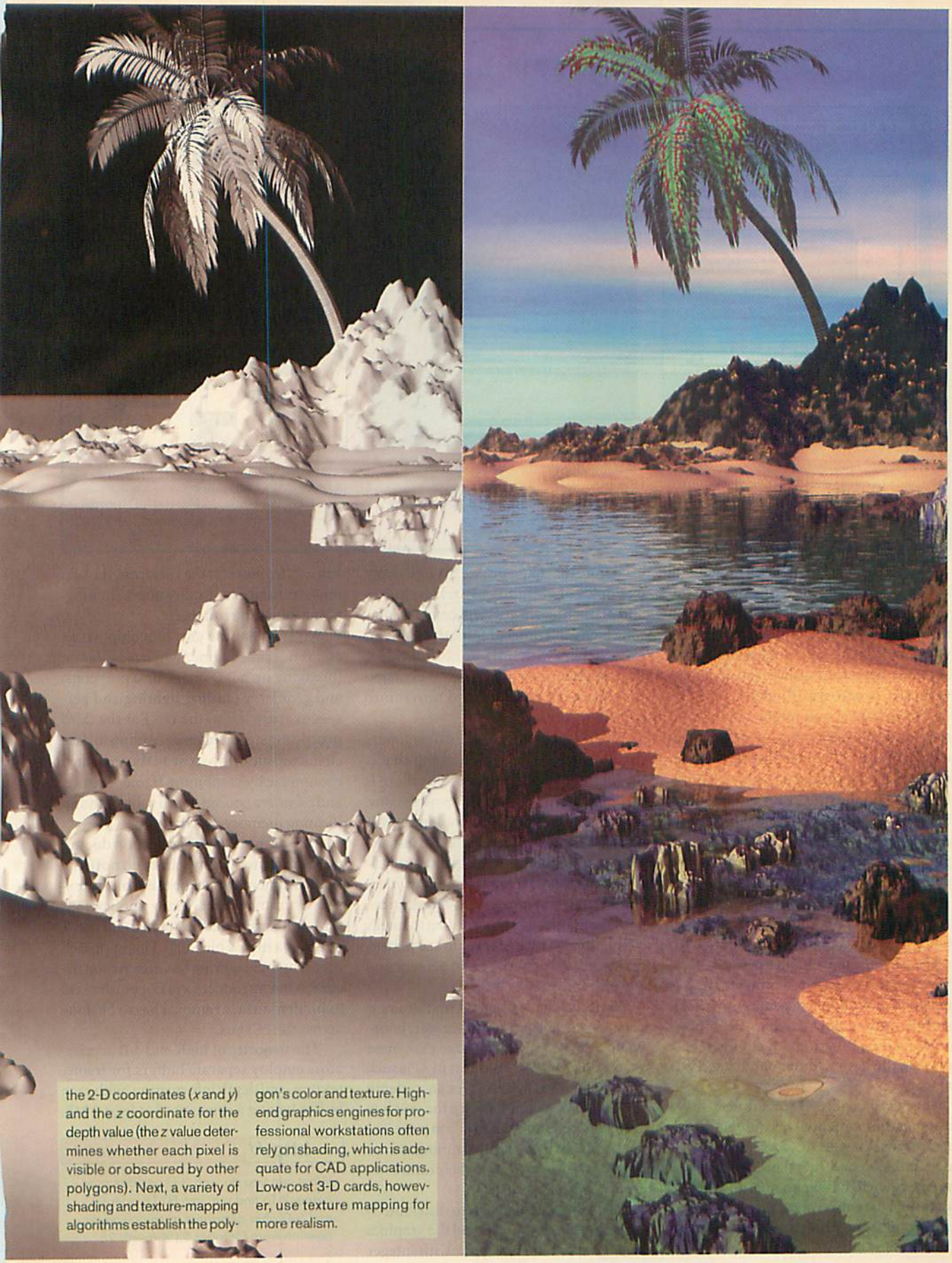


3-D processing, whether it's implemented in hardware or software, has three stages:

The *tessellation* phase creates a description of an object and converts it into a set of polygons.

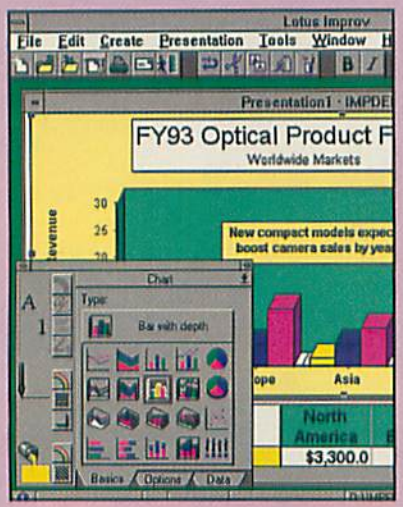
The *geometry* stage includes transformation, lighting, and setup. Transformation scales the scene and establishes perspective. Lighting determines color and reflections. Setup decides each polygon's shape.

Rendering manipulates



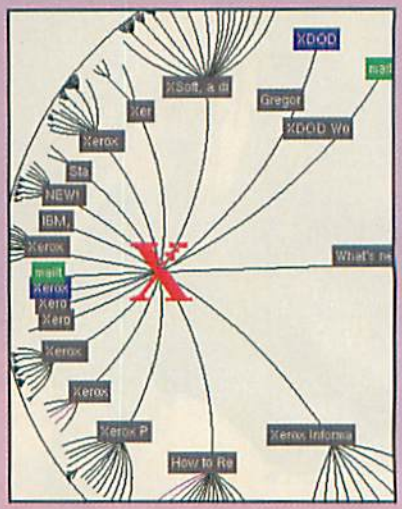
the 2-D coordinates (*x* and *y*) and the *z* coordinate for the depth value (the *z* value determines whether each pixel is visible or obscured by other polygons). Next, a variety of shading and texture-mapping algorithms establish the polygon's color and texture. High-end graphics engines for professional workstations often rely on shading, which is adequate for CAD applications. Low-cost 3-D cards, however, use texture mapping for more realism.

3-D Evolution



In the past, spreadsheets used visual tricks to simulate the 3-D experience. But you actually saw and manipulated data in 2-D space.

Competition is prompting games developers to actively devote resources to 3-D and to wade through problems caused by still-evolving API standards.



This hyperbolic view of a Web site, created at Xerox PARC, lets you browse a graphical map. It could be adapted for the 3-D browsing of hierarchical data structures.

To see the 3-D possibilities for general business applications, consider the advanced spreadsheets and databases that already work in three dimensions. Today you can populate a structural cube with data and then slice and dice it horizontally, vertically, or across a 3-D plane.

For instance, you might set up a 3-D spreadsheet to hold a year's worth of sales data, with each 2-D sheet listing the sales of a number of products for one month. Each layer of the spreadsheet holds information for a different month. To view the annual sales of a single product, you simply cut across the cube to retrieve the product's data for all 12 months.

The problem with this approach lies in viewing such a data cube on a flat surface. Once you cut across the cube, today's 3-D spreadsheets simply build a new 2-D view. Developers have tried to simulate the 3-D experience by adding slick interface tricks, such as drilling down on data by double-clicking on a functional heading or displaying the data within complicated 2-D matrices.

But in the end, 3-D spreadsheets have not met their potential because of the inherent weaknesses of working with 3-D data in 2-D space. In a true 3-D environment, you will be able to not only build a data cube but also rotate the cube in 3-D space and arrange the data in enlightening new ways.

Before that happens, we may see many examples of gratuitous 3-D. Developers and marketing wizards will concoct spinning logos and other graphical gimmicks, eye-catchers with little or no real value. But user-interface (UI) design is evolving to grasp 3-D's potential and turn it into something useful.

Whether or not software developers quickly turn 3-D into something that is useful for business applications, there is no doubt that ubiquitous 3-D is on the way. Consider Intel's MMX technology. MMX adds 57 new instructions to the x86 instruction set to accelerate multimedia applications, such as 3-D and 2-D graphics, video, audio, speech synthesis and recognition, and communications. According to Intel's simulations, we can expect to see performance boosts of between 50 percent and 100 percent.

MMX is slated to appear first in a new version of the Pentium processor, code-named the P55C, which is due early next year. Look for MMX support in APIs such as OpenGL and DirectX. (For an in-depth look at MMX technology, see the text box "MMX Accelerates the x86 " on page 79.) AMD and Cyrix are both planning to support MMX instructions in their future microprocessors.

There are various ways to distribute 3-D tasks between the CPU and the graphics chip. Graphics boards work with integer values; therefore, at the very least, the CPU must translate an application's floating-point values into integers.

Most often, the graphics chip works as a rendering engine, while *tessellation* (breaking up a 2-D image into polygons) and *geometry* (adding lighting and perspective) are left to the PC. For the third processing step, *rendering* (adding surface characteristics), low-cost 3-D boards often economize by combining frame, texture, and *z-buffers* (stored depth values) and allocating memory dynamically.

For example, if an application doesn't need a z-buffer (many games do not), the available memory can be used for the texture or frame buffer. Many applications set up the frame buffer in main memory, which is a mixed blessing: This approach saves cost by requiring less memory on the card, but it introduces a major bottleneck, as hidden surface removal has to be done across the PCI bus.

The majority of high-end 3-D accelerators employ separate buffers for frame, texture, and depth information, with each buffer having a capacity of at least 2 MB.

http://www.byte.com/

What can you do with 3-D besides play games? To find out, join BYTE editors and 3-D chip designers in an on-line discussion from October 21 through 25.

MMX Accelerates the x86

To improve multimedia and 3-D processing, Intel's new MMX technology can pack multiple pixels into one register and manipulate them with a single instruction. In effect, MMX brings a new level of parallelism to x86 processors.

Instead of adding new physical registers to the x86 architecture (which would slow MMX's adoption), Intel reuses the existing floating-point (FP) stack as logical MMX registers. MMX instructions use only the 64-bit mantissa portion of the 80-bit FP registers, ignoring the 16-bit exponent portion. This yields eight 64-bit logical registers without significantly altering the x86 architecture.

MMX instructions can pack several data types into these 64-bit registers: packed bytes (eight per register), packed words (four per register), packed doublewords (two per register), and a quadword (one 64-bit value per register). These data types are useful because multimedia programs typically work on small units of data. For example, a color pixel in TrueColor mode, the highest commonly used color resolution, uses 24 bits: 1 byte for each RGB color. This mode allows up to 16.7 million colors, more than the human eye can discern. In HiColor mode, only 16 bits are needed for a pixel. For many graphics applications, 16 bits is more than enough.

New x86 processors that support MMX will address the new registers as MM0 through MM7. Instead of treating the registers as a stack—as FP instructions do—MMX instructions can access the registers directly. When switching back and forth between FP and MMX instructions, the existing FSAV instruction saves the state of the registers, and the usual FRSTR instruction restores the values. This keeps MMX technology compatible with existing OSes, which frequently must save and restore the registers when context-switching between multitasking applications.

The downside is that programmers can't mix FP and MMX instructions together because they need the same registers. But this is not as significant as it sounds, since multimedia programs typically perform their FP operations before displaying the data. (Rendering relies more heavily on integer instructions.)

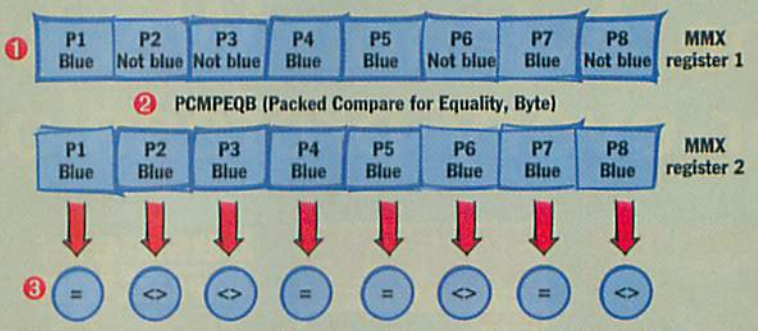
MMX introduces a set of general-purpose integer instructions that use the single instruction/multiple data (SIMD) paradigm. One instruction processes the multiple data in the packed registers. This parallelism increases performance. Incidentally, this concept is not new at Intel. Years ago, the now-obsolete i860 RISC family featured a similar technology, called Pixel Addressing Extension (PAX).

Another feature of the new instruction set, parallel-compare operations, could improve performance by eliminating branches. (Modern processors try to predict branches, but a misprediction means a penalty of several processor cycles.) Combined with packed data features, parallel-compare operations are useful when, for example, you want to combine or overlay two images.

The MMX instructions are similar to those in Sun's Visual Instruction Set (VIS) for the UltraSparc. VIS also packs registers and uses the FP registers. But it has a lot more to offer than MMX: 32 new registers (compared to Intel's eight), accelerated video decompression with discrete cosine transformations, more-powerful addressing modes, pixel masking, and a highly specialized set of operations that greatly accelerates motion estimation when compressing MPEG video streams.

MMX isn't Intel's only new approach to accelerating 3-D. Another new extension for 3-D accelerators is the Advanced Graphics Port (AGP). To evenly distribute main-processor tasks and graphics-chip tasks, the AGP creates a new data path for data transfers between main memory and the graphics card's frame buffer. By skipping the PCI bus altogether, AGP can theoretically allow read and write transfers at speeds up to 400 MBps, according to Intel.

Parallelism Speeds Performance



1. MMX instructions can pack 8-, 16-, 32-, or 64-bit values into the 64-bit MMX registers. Here, eight 8-bit graphics pixels are packed into a single register.
2. When an MMX instruction executes, all eight pixel values in each MMX register are processed simultaneously. (Here, the instruction compares pixels in registers 1 and 2 for equality.)
3. The results of the comparisons. The parallelism gained by having a single MMX instruction process multiple pixel values is faster than if separate instructions had to be issued for each comparison.

However, the cost of buffer memory alone keeps these products out of the mainstream market.

The 3-D Hardware Wave

Although 3-D accelerators divvy up processing tasks in similar ways, 3-D chip architectures can vary considerably. Some chips are programmable, such as Rendition's RISC-based Vérité and Chromatic's Mpact, which uses a very-long-instruction-word (VLIW) architecture. Two other programmable chips, the TM-1 from Philips and the Mfast from IBM, were not yet shipping at press time.

The performance of programmable 3-D chips depends to a large extent on the low-level software that drives them. Both Rendition and Chromatic currently supply such firmware. OEMs that write their own low-level software can enhance these processors with new features, data formats, or algorithms.

The Mpact's Mediaware microcode

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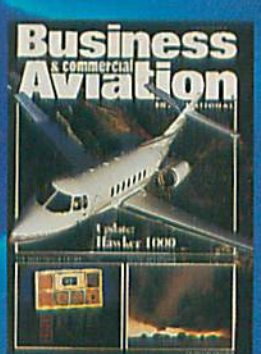

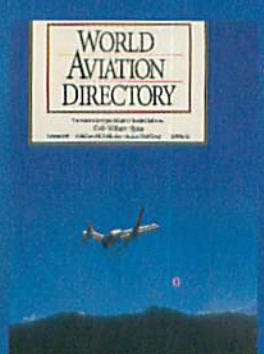

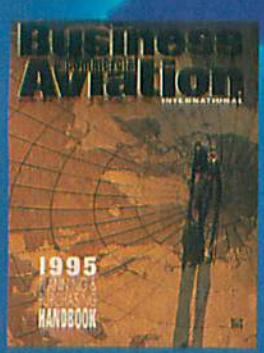

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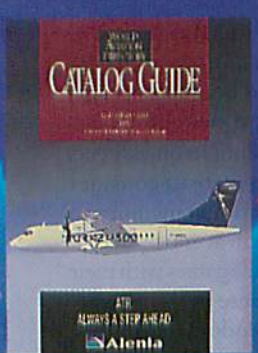

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modules allow systems designers to enable or disable specific functions—such as 3-D graphics, videoconferencing, and telephony—to create a single hardware design with a number of different personalities. Unlike the Mpact, the Vérité was designed specifically for 3-D acceleration. It includes a hardwire "pixel pipeline" for critical 3-D operations, such as texture mapping and blending, while the RISC core is responsible for geometry setup and filtering; this relieves the CPU of the majority of the 3-D work load.

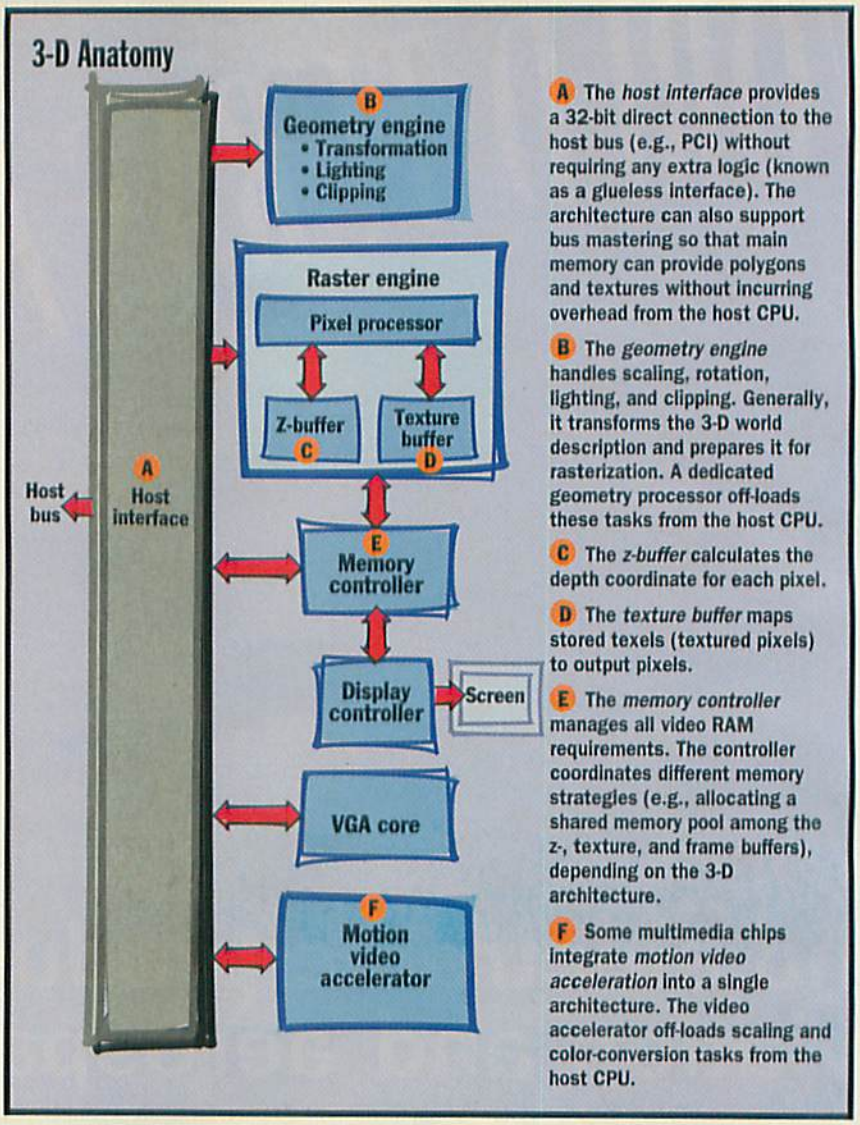
Hard-wired solutions, such as those from Nvidia, 3Dfx Interactive, and 3Dlabs, sacrifice this flexibility but often achieve higher performance. As APIs and other standards evolve, customers must depend on these vendors to update their designs quickly or, in some cases, to develop new software drivers to support the emerging standards.

Nvidia's NV1 requires additional developer support because of its proprietary curve primitive. Instead of building curved surfaces from small polygons, the NV1 generates curves directly to dramatically improve performance when an application requires textured curves. The drawback is that developers must port applications to the Nvidia chip before they can take advantage of these curve primitives.

Many of the graphics companies now offering low-cost 3-D chips and boards have been selling to the 2-D graphics market for years. They offer their customer base a terrific advantage: The new 3-D chips are pin-compatible with the previous generation, so the 3-D chips can slip into a proven card design. For example, the S3 Virge is pin-compatible with the popular S3 Trio64V+. On the downside, not all of these mainstream graphics vendors have the expertise of the established 3-D companies.

3Dfx is one of the few companies in the low-cost 3-D market with a strong 3-D résumé. The firm has made a business of replacing the expensive proprietary engines used in dedicated arcade machines with high-performance Pentiums. Focusing on this specialty, 3Dfx has designed a dedicated 3-D chip that delivers impressive 3-D acceleration but lacks integrated functionality, such as standard GUI acceleration and motion-video playback.

A dedicated 3-D solution does not replace a PC's graphics card; instead, it complements it with a "pixel pump" that works in parallel with the graphics accelerator that's on a separate PCI board. After the 3-D chip calculates the pixels, they pass across the PCI bus to the graphics card.



Like the 3Dfx Voodoo Graphics accelerator chip set, VideoLogic's PowerVR is a dedicated 3-D chip that requires an existing graphics accelerator. To compete with integrated solutions, 3Dfx has formed a partnership with Alliance semiconductor to combine the Voodoo with Alliance's ProMotion graphics controllers.

Bring on the Boards

Now that 3-D chips are appearing on commercial boards, we are seeing some 3-D warts along with the glitter. One particularly unpleasant surprise is that 3-D acceleration in many low-cost boards works only in one mode—namely, at a resolution of 640 by 480 pixels with 64,000 colors.

This is fine for play, since today's 3-D games don't require any more screen real estate than that. But this situation will eventually change. As more business applications use 3-D, 640 by 480 is becoming all but useless, and switching back and forth between resolutions quickly gets tedious. It's better to instead consider cards that accept additional memory to support 3-D acceleration at 800 by 600.

Many vendors bundle games with their 3-D boards. Some of these games use special features of that vendor's hardware; we've even heard of programs that use a high-level API, such as Microsoft's DirectX family of interfaces, and still use hardware references to stop users from switching horses. In addition, games developers are fond of squeezing every last bit of performance out of the hardware.

Since the jury is still out on how much of a performance penalty the multiple software layers in Microsoft's 3-D APIs will inflict, some people might be tempted to

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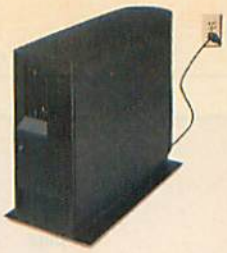

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3-D Chip Features

	ATI Rage	3Dfx Voodoo	3Dlabs Permedia	Chromatic Mpact	Matrox MGA-1064SG	Nvidia NV3	Oak OTI64311	Rendition Vérité	S3 Virge	Trident T3D9695	VideoLogic PowerVR
Memory/buffering											
Memory required (MB)	1	2	2	2	2	2	1	2	2	2	2
Memory type	SGRAM	EDO	SGRAM	RDRAM	SGRAM	SGRAM	EDO	EDO	EDO	SGRAM	EDO
Texture buffer required		✔			✔		✔				✔
Z-buffer required	✔	✔				✔					
3-D features											
Antialiasing	✔	✔		✔			✔	✔			
Trilinear filtering	✔	✔		✔			✔	✔	✔	✔	
Subpixel positioning	✔	✔	✔	✔		✔	✔	✔	✔		✔
Atmospheric effects	✔	✔	✔	✔		✔	✔	✔	✔		✔
Integrated features											
2-D acceleration	✔		✔	✔	✔	✔	✔	✔	✔	✔	
Video acceleration	✔		✔	✔	✔	✔	✔	✔	✔	✔	
RAMDAC	✔				✔		✔		✔	✔	
Video out	Optional				Optional		✔			✔	

All chips support the following features:

Alpha blending
Dithering
Double-buffering
Filtering (point-sampled, bilinear)
Graphics primitives (points, lines, triangles)
MIP mapping
PCI interface (glueless)
Perspective correction
Rastering
Shading (flat, Gouraud)
Textures

✔ = yes.

bypass them. In the long run, only hardware and software that supports the relevant APIs will survive. Until then, shoppers should select a board that has all the drivers needed for it to perform with the software they expect to use.

If you have a high-performance graphics board and just want 3-D acceleration, then something like VideoLogic's PowerVR, working in parallel with the main graphics board on a separate PCI card, could be an ideal solution.

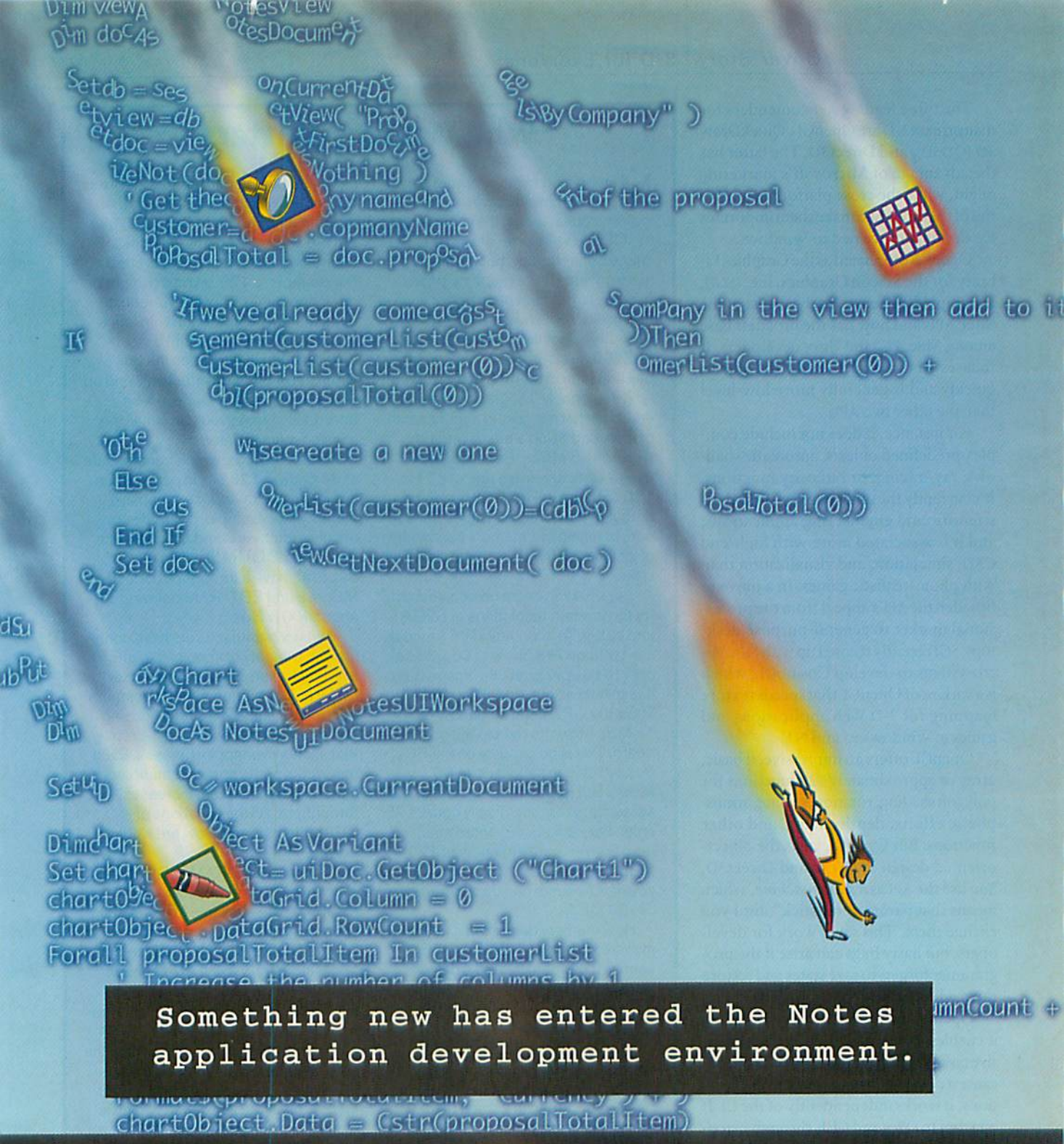
Nonstandard 3-D

Currently there are about 50 APIs for 3-D. This situation is not conducive to matching the hardware flood with the ground swell of cool mass-market applications.

APIs—the libraries of boilerplate routines that define standard sets of graphics functions—give programmers "hooks" into an otherwise-closed environment, such as an OS, a database, or hardware drivers. In the 3-D arena, APIs also function as an isolating layer to protect applications programmers from the idiosyncrasies of proprietary hardware. *continued*

3-D Glossary

- **Alpha blending:** Support for true object transparency in hardware. An alpha value defines the transparency of each pixel. The accelerator takes this transparency value into account when drawing objects, perhaps by blurring an object when it passes behind a transparent object or changing the color of a transparent foreground object to match that of a background object.
- **Antialiasing:** An antialiasing algorithm will slightly blur diagonal lines and other effects to better simulate a smooth line.
- **Atmospheric effects** (fogging and depth cueing)**:** Fogging creates a haze over a scene. Depth cueing changes the color and hue of an object in accordance with the object's distance from the viewer.
- **Bilinear versus point-sampled filtering:** To interpolate pixels, some low-end 3-D algorithms take the nearest adjacent pixel (i.e., the nearest neighbor sampling) and replicate its color. Small on-screen movements can cause full pixels to change color, causing aliasing and unwanted screen artifacts. Bilinear filtering averages the 4 nearest texels (textured pixels) to interpolate a pixel, producing a higher-quality image.
- **MIP mapping:** When a texture is applied to an object, it often has to be resized or stretched to fit. This process degrades the texture image. MIP mapping creates three or more copies (called MIP *levels*) of the texture, each of a different size, so that the best-fitting copy can be used.
- **Perspective-correct texture mapping:** Texture maps that continually change to match the perspective of the viewer.
- **Subpixel positioning:** If a line does not run directly through a pixel, it must be moved to the nearest one, which introduces positional error. Pixels can be broken down into smaller subpixels in memory so that the line can be drawn to the nearest subpixel.
- **2-D and GUI acceleration:** If your 3-D accelerator also acts as your primary graphics card, make sure that it supports 2-D and GUI acceleration. Otherwise, the performance of your standard Windows applications will degrade noticeably.
- **Video acceleration:** If your applications include motion video, look for an accelerator that supports hardware video acceleration. Video acceleration performs color-space conversion and scaling in hardware, removing that chore from the host CPU and improving the quality of video clips.



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The three leading API contenders for mainstream 3-D are OpenGL, QuickDraw 3D (QD3D), and Direct3D. The latter has the advantage of Microsoft's marketing might, while the cross-platform capabilities of the other two make them important for developers not tied to Windows.

OpenGL originated as the Graphics Library for the Silicon Graphics, Inc. (SGI), Iris graphics systems. It's the oldest of the three APIs and now has the broadest base among Mac, PC, and Unix developers. It focuses on drawing 2-D and 3-D objects quickly and is generally more low-level than the other two APIs.

For instance, it does not include complex predefined objects, automatic shadows, ray-tracing, or radiosity functions. It's currently the undisputed standard for scientific and engineering applications, and it is associated more with high-end CAD, simulation, and visualization than with photo-realistic games. In a move to broaden the API's appeal from the professional market to general-purpose desktops, SGI recently teamed up with Sun Microsystems to develop CosmoGL, which is a variant of OpenGL that speeds texture mapping for 3-D Web applications and games in Windows 95 and NT.

OpenGL offers an impressive, if basic, array of approximately 120 functions for polygon shading, rotation, scaling, atmospheric effects, depth cueing, and other functions. But OpenGL lacks the object-oriented design of QD3D and Direct3D. You use the API as a *state machine*, which means that parameters "stick" until you change them. This saves work for developers, but nasty bugs can arise if the programmer forgets to save states and restore them when exiting from a routine.

OpenGL uses a client/server model, so it enables you to process compute-intensive tasks in a distributed environment. Because it does not include windowing functions, it works independently of the UI. It attaches to OSes and GUIs through extension libraries.

OpenGL is complemented by Open Inventor, a higher-level, object-oriented library. You can use Open Inventor as a layer above OpenGL to add features such as geometry, motion and lighting, and material editors. Like OpenGL, Open Inventor has been licensed to other companies. For instance, the Virtual Reality Modeling Language (VRML) format for virtual worlds on the Internet is based on Open Inventor.

continued

Why Memory Matters

Memory and memory speed play pivotal roles in how realistic 3-D looks on our screens. It's important for the CPU to write pixel data to the image buffer quickly, but it's much more critical for the graphics-board circuitry to get data out to the screen.

The old VGA standard of 640- by 480-pixel resolution required a total of 307,200 pixels; at 16 colors, these pixels fit into 153,600 bytes of memory. A reasonably fast graphics driver would fill that memory in about a tenth of a second using a memory bandwidth of 1.5 MBps. Because VGA uses a vertical-refresh rate of 60 Hz, 150 KB of image memory had to be output to the screen 60 times per second, resulting in a memory bandwidth of just of over 9 MBps on the video side.

The situation heats up considerably for the modern resolutions of SVGA and better. To accommodate a moderate 1024 by 768 pixels at 65,536 colors (16 bits per pixel), the image buffer has to hold about 1.6 MB of data. Thus, the CPU needs a bandwidth of 16 MBps to write data to the graphics board. This is no big deal on the PCI bus, which can handle up to 60 MBps. But to get the image out to the screen at an ergonomically correct 75 times per second, the board must read from its image memory at 120 MBps. For 1280 by 1024 resolution, you need a sustained throughput rate of 196 MBps.

How memory delivers this performance depends on the bus width used in the graphics card's design. Basically, more memory bandwidth can be achieved either with faster memory chips or by using several chips in parallel. ISA-bus graphics boards and their chips were generally designed for a data-bus width of 16 bits; to support high screen resolutions, you need fast video RAM (VRAM).

VRAM chips are dual-ported: To the graphics chip, they look like standard DRAMs, but a second port is used for output. Thus, data can be read and written simultaneously; screen updates do not result in lost cycles. A recent development, Window RAM (WRAM), is basically faster VRAM enhanced with special graphics features, such as accelerated, aligned fills and moves.

Given that memory comes in a fixed bus width, watch out for boards that support a bus width of 64 or 128 bits but are sold in economy versions where only half the memory is fitted. For example, a 128-bit board might be designed for 4 MB of RAM, needing eight memory chips, each with a bus width of 16 bits. If only 2 MB is installed, which degrades the bus width to 64 bits, you effectively end up with a lower-performance, 64-bit board. Of course, you can install the missing memory later.

Modern boards, which transfer data at 64 or even 128 bits in parallel, can actually use slower, less expensive memory. For example, board designers can combine standard extended data out (EDO) RAM with a 64-bit bus to achieve a throughput of 240 MBps. Burst EDO RAM delivers about 400 MBps.

Memory manufacturers have come up with a variety of special designs for even-faster throughput, needed for larger color palettes. Some designers put several chips in a single housing and combine them with logic circuitry that allows overlapping access. Each unit works at the speed of standard DRAM, but parallelism increases throughput. All the variations of DRAM described below are single-ported.

Synchronous DRAM (SDRAM) and synchronous graphics RAM (SGRAM) are available from several sources and have already found a flock of followers in the graphics-controller industry. While DRAM needs several special strobe signals, synchronous RAM can handle the memory clock directly. At a bus width of 64 bits, SDRAM can support bandwidths up to 640 MBps. SGRAM adds features that accelerate graphics performance, such as block write (which is useful for video).

Multibank DRAM (MDRAM) combines eight 32-KB banks into blocks of 256 KB. It supports 500-MBps throughput. Tseng Labs' ET6000 graphics chip sports a special 128-bit MDRAM interface, yielding up to 1000 MBps.

Rambus DRAM (RDRAM), a general-purpose memory design, has a bus width of only 8 bits and therefore needs a very high memory clock of 250 MHz. Transfers reach 500 MBps.

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QD3D, which premiered in early 1995 as a graphics extension to the Mac OS, now includes Windows support. Because QD3D is fully object-oriented, new object instances can inherent complex features (including lighting, geometry, and textures) to simplify the construction of 3-D images.

QD3D stores scene and object information with its own portable data format, which is called 3D Metafile (3DMF); it offers a choice between a compact binary and a human-readable version and supports the cutting and pasting of 3-D objects via the Clipboard. You can store QD3D objects in image databases and use simple drag-and-drop techniques to move objects from the database into a 3-D scene.

QD3D includes standard 3-D primitives, but, unlike OpenGL, it knows about complex geometry, such as nonuniform rational B-splines (NURBS). Its extensible architecture enables you to add new software-rendering engines and access hardware accelerators. Another nice detail is the interactive renderer, which lets you see and manipulate objects directly during design. Many applications let you work with the interactive renderer directly.

For developers who'd rather work with a low-level, but still hardware-independent, 3-D API, Apple offers the Rendering Acceleration Virtual Engine. RAVE can act as a plug-in module within QD3D to provide a hardware abstraction layer (HAL). RAVE includes basic graphics primitives; however, it doesn't offer high-level functions, such as the importing of objects. Like QD3D, RAVE supports Macs and Windows-based machines.

Microsoft's Direct3D, the latest member of the DirectX family of interfaces, is part of a three-layered structure (Direct3D itself is actually the middle layer). The lowest layer is the HAL, which contains the hardware-specific device drivers. Above that is the low-level API layer, which grants access to hardware features while maintaining hardware independence. The layer above it contains Microsoft's own high-level API, previously known as RealityLab (which was snagged in Microsoft's acquisition of RenderMorphics). This highest layer can also accept other APIs as plug-ins, including OpenGL. Above these three layers is the applications layer; below them lies the hardware.

Applications built on the DirectX family can query the system to determine what functions are implemented in hardware. For functions that are not supported, the application might substitute a simpler algorithm. However, Direct3D can also emulate any function in software, thanks to the Hardware Emulation Layer (HEL).

Like QD3D, Direct3D offers a clean, object-oriented, extensible architecture. What functions are actually available depends to some extent on the high-level layer. With the default RealityLabs API on top, Direct3D is not as versatile as QD3D because it lacks basic 3-D objects, such as cylinders, spheres, and cones. Still, it offers functions that go beyond OpenGL's, including animation features, which are particularly useful for games developers. Direct3D's main drawback it that it's limited to Win 95.

The 3-D Future

Eventually we may take 3-D for granted, much like gigabyte-capacity hard drives and 16 MB of memory. However, because 3-D adds complexity to applications, it will take a fair amount of time for software developers to master the technology. Therefore, we probably won't see 3-D hit critical mass until 1997 or later. Until then, only games publishers, who stand to profit first and most by 3-D, will be willing to devote significant resources to the development of 3-D.

Just like the GUI-enhanced software that seemed so cumbersome to users for many years, 3-D will suffer many development blunders along the way before killer 3-D apps emerge and 3-D UI elements become as natural and efficient to use as today's dialog boxes and scroll bars. And as 3-D becomes pervasive, business users will need, rather than just want, 3-D enhancements. B

Udo Flohr is a BYTE contributing editor based in Hannover, Germany. You can reach him at **flohr@dfn.de.**

API
Strengths and Weaknesses

OpenGL

+ Supports Mac, PC, and Unix developers.
+ Quickly draws 2-D and 3-D objects.
+ Offers an impressive array of rendering functions.
- Not object-oriented.

QuickDraw 3D

+ Supports the Mac OS and Windows.
+ Fully object-oriented.
+ Lets you drag and drop objects into a 3-D scene.
+ An interactive renderer manipulates objects during design.

Direct3D

+ A member of the DirectX family of interfaces.
+ Offers a clean, object-oriented, extensible architecture.
- Not as versatile as QuickDraw 3D, because it lacks some basic 3-D objects.
- For Windows only.

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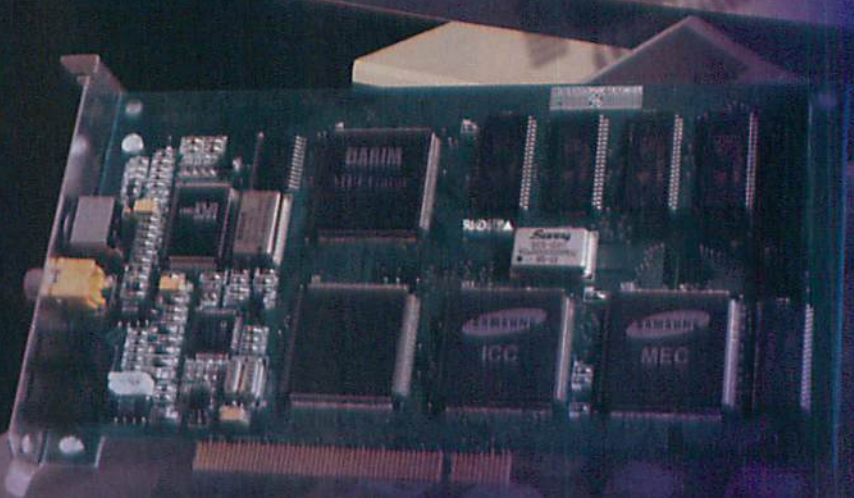


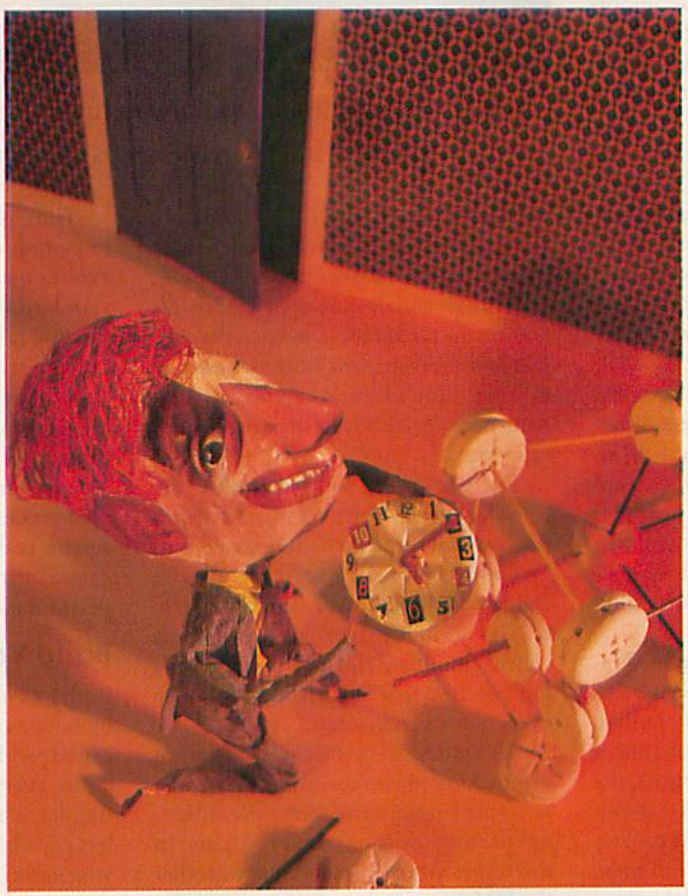
NT in Real Time

Clever modifications of Windows NT make it a compelling OS choice for some embedded applications.

By Rick Grehan

Pity the embedded-systems developer when it comes time to choose a real-time OS (RTOS). The approximately 40 RTOSes now on the market present an embarrassment of riches; each one offers slightly different capabilities and development tools. So, for a developer on a deadline, he or she may spend a lot of valuable time searching for the right tools—time that would be better spent developing the actual program.

Life would be easier if embedded-systems developers needed only to choose among a handful of general-purpose OSes, such as Windows NT, that have been customized into embedded, real-time versions. Phar Lap Software and Venturcom are doing just this kind of customization: Both are offering real-time variations of NT. The approaches these two organizations take with their products are quite different, but both of them count on catching some of NT's wake.



NT's Coattails

The potential rewards of using Phar Lap's TNT Embedded ToolSuite, Realtime Edition, version 8.0 (ETS), and Venturcom's Real-Time Extension (RTX) are manifold. First, if you're already familiar with programming to NT's API, you don't have to go to the trouble of learning a new API to use them. All the programming knowledge that you've gained while working with NT in the desktop realm becomes applicable for real-time applications.

Second, programmers can choose from a wide range of development systems. Custom real-time OSes often require the purchase of equally custom and expensive development tools. By contrast, developers using ETS or RTX have the option of using standbys, such as Microsoft's Visual C++ and Borland C++. Along with these tried-and-true development tools come some substantial piles of documentation and various other educational materials that are often missing in some custom OSes.

Third—and most important—both the host-development and target systems can run the same OS. This means that a great deal of the software development work can be completed before the target hardware is even available to the software engineers. (Venturcom's RTX runs on any Intel hardware that supports NT. Phar Lap's ETS supports standard AT architectures, starting with the 386SX.)

The Challenge

Embedded-systems developers have a short list of "must have" features for any RTOS, whether it's a custom design or one built from a general-purpose OS. For example, a multithreaded RTOS with a moderately sophisticated memory management system must be able to safeguard against the memory-manager thread's waking up and preempting a time-critical interrupt service routine. (The memory-manager thread operates at a high priority to maintain system consistency.)

Such safeguards are critical to providing *determinism*. An RTOS is said to be deterministic if a designer is able to figure out precisely how the system will behave given any set of inputs and the current state of the system at the time the inputs arrive. Most of the time, this boils down to a known and guaranteed task-scheduling protocol.

Because embedded applications usually offer limited memory resources, another important characteristic of an RTOS is the ability to tolerate small living quarters. Some embedded systems must endure size and power restrictions; both translate directly to limits on the amount of silicon a developer can throw at the application. If the real-time system won't fit, no amount of shoehorning will fix the problem. Finally, an RTOS must provide adequate development tools.

Both ETS and RTX need to solve these problems *and* work

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compatibly with NT, even though NT doesn't natively provide the deterministic task-scheduling necessary for RTOSes. In addition, NT typically runs with applications that offer 32 to 64 MB of memory—which is hardly a small footprint. While development tools for NT are common, developers using the Phar Lap and Venturcom products need to use those tools in a specialized way.

Inside ETS

Phar Lap's ETS owes a great deal of its heritage to the company's venerable TNT DOS Extender. TNT brings a subset of the Win32 API into a DOS extender to provide developers with access to NT-style multithreading and all the NT-synchronization objects (e.g., events, critical sections, mutexes, and semaphores). Most important, however, is the fact that TNT is a 32-bit flat-memory-model environment. It's about as close to NT without the Windows as you can get. To produce ETS, Phar Lap took the basic TNT technology and added a context-switching and memory-managing heart to produce a stand-alone kernel.

Note that ETS is a single-process, multithreaded environment. It's important to remember that ETS is not *true* NT; it's based on a subset of the Win32 API. The context-switching component provides determinism via the following easy-to-remember principle: The highest-priority runnable thread will run. This means that a thread will run until it becomes blocked (e.g., while waiting for completion of an I/O operation) or its time slice expires and a thread of equal or higher priority is ready to run.

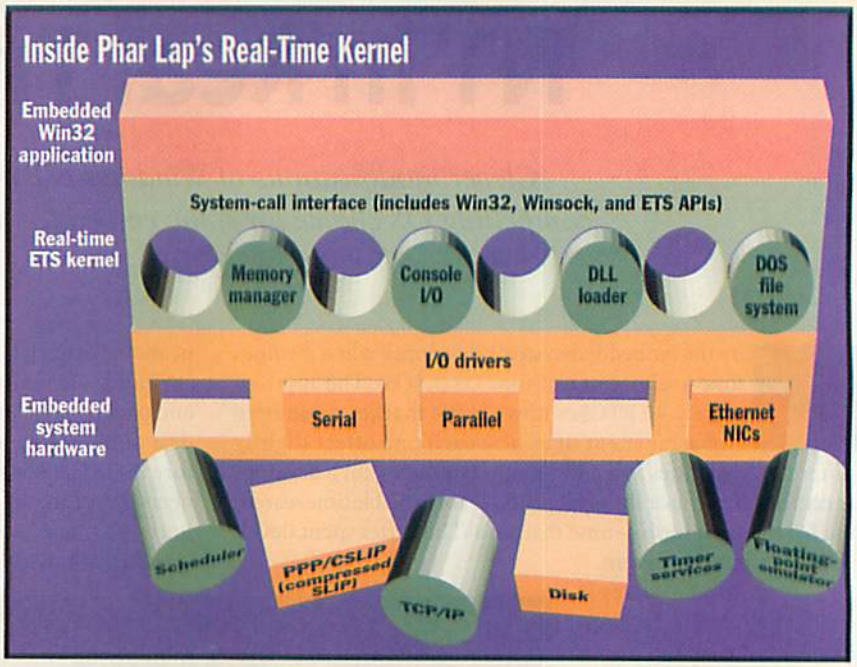
By contrast, task scheduling in Windows NT is not deterministic. Because ETS is basically a real-time kernel rather than a full-blown OS with its own development tools and supporting applications, it's aimed primarily at the embedded developer working in C and C++. Fortunately, ETS allows a development tool to be selected from among several of the standard NT C/C++ compilers. ETS applications can be constructed using Microsoft's Visual C++, Borland C++, or MetaWare High C/C++.

Well-Timed Interrupts

To understand Venturcom's RTX, you must first understand how NT's hardware abstraction layer (HAL) handles system timing. The HAL intercepts timer interrupts produced by a system's hardware clock. NT's designers programmed these interrupts to occur once per millisecond; the HAL essentially passes the interrupts "up" to the NT kernel. This once-per-millisecond interrupt, which forms the smallest resolution of the NT system, is used to manage device drivers that request timer services.

Every 10 ms, the NT kernel nudges the NT scheduler, which performs whatever process and thread scheduling needs to be done. Hence, 10 ms represents NT's fundamental process/thread time slice. RTX's real-time extensions depend on a cleverly modified HAL that programs the hardware so that interrupts occur once every 100 *microseconds*.

This modified HAL delivers interrupt notification in two directions. First, the new HAL continues to inform the NT kernel of interrupts once every 10 ms. In this respect, the NT kernel is unaware that the HAL is acting in a different manner. The second notification sequence, however, sends an interrupt every 100 µs to Venturcom's RTX. RTX is a sort of real-time kernel that appears to the remainder of NT as a device driver, so it's simultaneously a part of and separate from NT. Tasks running in RTX run at priorities higher than those of NT interrupt handlers. Consequently, RTX tasks cannot be preempted by NT tasks.



The ETS kernel lets you add or delete services and hardware device drivers to match the needs of each application.

Thus, NT's normal functions run unimpaired so that real-time software can execute on an NT system side-by-side with standard, off-the-shelf software. Also, because tasks in the real-time extension execute at a higher priority than NT processes and threads, NT tasks won't destroy the determinism of the real-time extension. Finally, developers can use RTX for SMP (symmetric multiprocessing). On a dual-processor system, one processor can run the real-time extension, and the other one can run NT with no degradation in performance.

Build Your Own Kernel

Both ETS and RTX address the resource limitations of embedded systems via associated products that let you custom-construct a kernel. Phar Lap's Visual System Builder, which comes bundled with ETS, lets you identify what pieces you want in your kernel (e.g., keyboard driver or timer driver). Operating Visual System Builder is straightforward: You simply click on check boxes that correspond to the desired components, and the Builder automatically assembles the proper modules. When you compile and link your application's executable image, ETS pulls in the selected modules.

RTX's optional Component Integrator is more elaborate because it helps you assemble a customized version of a full-

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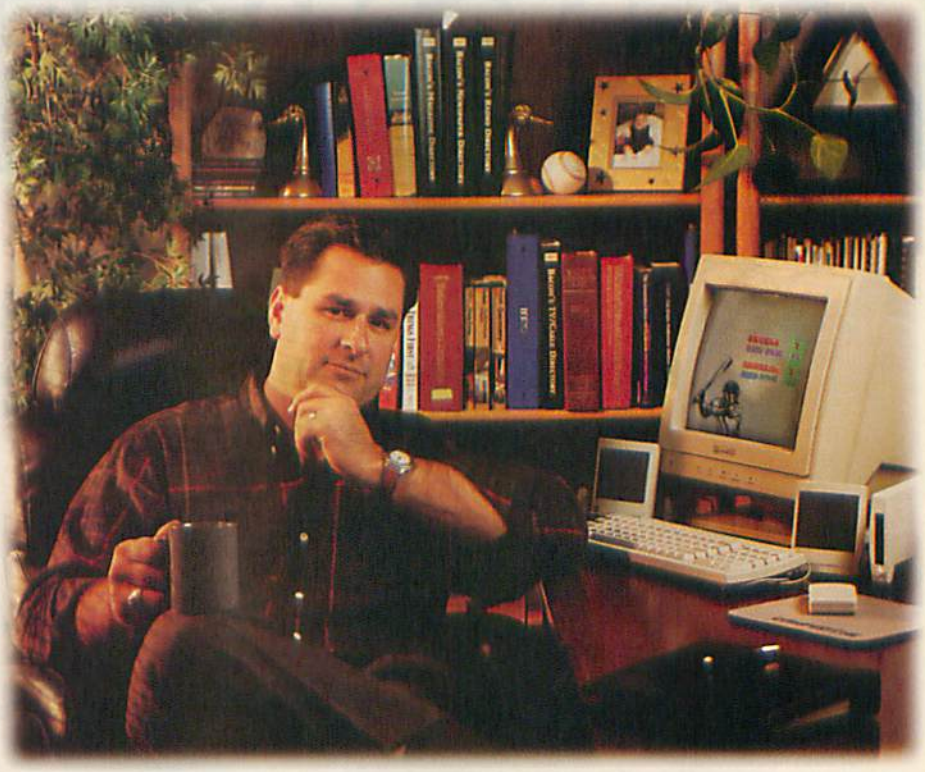

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blown NT system. The modules that the Component Integrator must cope with are more complex than keyboard drivers and serial drivers, and these modules are also interdependent. The ultimate goal, however, is the same for both ETS and RTX. Each one allows you to construct a tuned OS core that has only the pieces your application needs.

How do the two products compare in scalability? That depends on your perspective. Developers who measure ETS by its ability to bear the burden of increasing numbers of tasks find that the product fares well. For example, Ark Degtiarov, principal software engineer for Nova Biomedical, a Boston-based biomedical instrumentation manufacturer, says that his company's blood-analyzing system runs about 40 simultaneous tasks using ETS. He adds that he has never seen a problem with system stability.

Developers might measure scalability with Venturcom's RTX by the number of NT services that are available in conjunction with RTX. Given that, the Component Integrator provides all the scalability necessary at the upper end of the spectrum; there's no reason why a full-blown NT kernel can't be run in conjunction with RTX.

For a deeply embedded application, however, there's a lower end to the spectrum. A minimum embedded NT system with RTX requires about 8 MB of memory (5 to 6 MB for NT, and the rest for the embedded application). ETS fares much better in tight spaces; depending on how the kernel is carved up, it can take as little as 27 KB of memory.

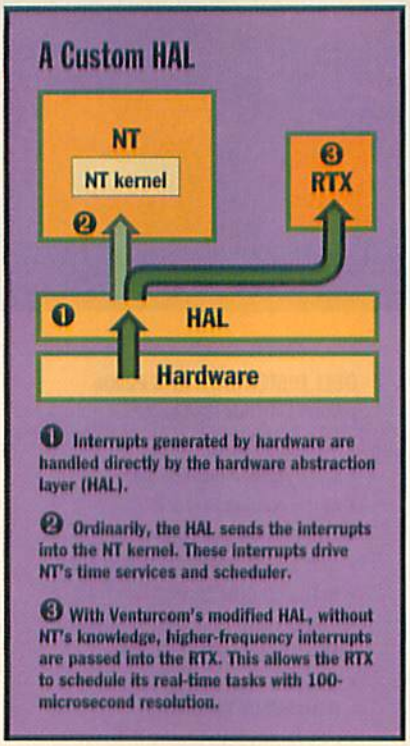
The Dark Side

Before you think that these products offer perfect solutions, consider some of their drawbacks. For starters, Venturcom's RTX is in an early incarnation and currently supports only soft real-time. In other words, RTX's high-performance, deterministic characteristics have not yet been implemented—and this is not expected until later this year or early 1997. (A "hard" real-time system guarantees an immediate response to a given stimulus regardless of the system state. In contrast, a "soft" real-time system can tolerate an occasional fraction-of-a-second delay. For example, microwave ovens are soft real-time systems; you wouldn't notice if the oven responded in 7/10 second, rather than 1/10 second, after you pressed the Start button.) In defense of the product, the company claims soft real-time satisfies 95 percent of the real-time marketplace.

Then there's the aforementioned RTX footprint of about 8 MB. On one hand, this excessive memory requirement exists because RTX runs full-blown NT, not some subset of the Win32 API. On the other hand, this is likely to eliminate RTX from consideration for many deeply embedded applications.

Phar Lap's ETS tackles the real-time embedded market at a lower level than RTS does. This means you'll need to program in C or C++ if you choose to work with it. This isn't completely a fault of ETS; it's intrinsic to hard real-time development. However, this means that the ETS environment is more primitive than what RTX offers. With ETS, you can't currently run an off-the-shelf database package alongside your real-time data-acquisition system.

Note that this primitiveness does not imply higher performance on the part of ETS. (It's often the case that the lower an application's level, the higher its raw performance.) On the contrary, one complaint about ETS is its poor latency (i.e., the time it takes the system to respond to an interrupt). Additionally, the minimum time slice for threads running under ETS is 10 ms (the same as for a "regular" NT thread). Compare that to RTX, which can schedule real-time threads in 100-µs time slices.



RTX relies on a customized HAL that lets NT operate in real-time applications.

The Choices

These two products take fundamentally different approaches to handling NT. Therefore, you shouldn't have much trouble distinguishing when it's best to use one rather than the other.

Venturcom's RTX and Component Integrator target the high end of the embedded marketplace. These tools benefit applications that incorporate a mixture of real-time and desktop software.

Imagine, for example, a system that controls a complex manufacturing process and perhaps runs a factory's automated assembly line. The shop-floor manager—who's already familiar with the NT interface on the desktop in the office—can go to the shop floor and use the same graphical interface to reprogram the assembly line. If this reprogramming task requires that a set of device-control parameters be called up from a database, this could be done with an Access database that communicates directly with the real-time extension tasks that control the devices on the assembly line.

Meanwhile, Phar Lap's ETS works efficiently with deeply embedded applications where resources (available memory, for example) are scarce. Small, application-specific devices that don't require graphical interfaces or a great deal of mass storage are perfect candidates for ETS applications.

In addition, both of these products face some stiff competition from Unix-based RTOSes, such as QNX and Lynx. Still, NT is one big rolling snowball. And although NT is just now entering the embedded world, developers may feel safer working behind the snowball rather than in front of it. B

WHERE TO FIND

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Rick Grehan is a BYTE senior technical editor who frequently writes articles about embedded-systems programming. You can reach him at **rick_g@bix.com**.

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How to Tame Big Networks

Whether you're designing, simulating, or maintaining extra-large networks, smart software tools can help.

Quantity has a quality all its own. While running a 10-node network might be challenging, and handling a 100-node network might be absorbing, designing and maintaining a 1000-plus-node network are harrowing tasks. The larger the network, the more likely it is to contain a variety of hardware platforms, OSes, connection schemes, and protocols that span countries and continents. In short, bringing order to this potential chaos is more than a single, mortal administrator can handle.

The mega-network administrator's primary concern, of course, is how to foist off this crushing burden. The good news here is that tools exist just for this purpose.

For example, designing a large network or adding onto your existing behemoth can be taxing, since you have to consider so many parameters, including throughput, location, compatibility, size, and budget. New graphical tools let you assemble big networks from databases of components as if you're piecing together Tinkertoys—and smart Tinkertoys at that, since some of these tools can tell you if you're making blunders such as using an underpowered server for an engineering workgroup.

If instead of designing a network from scratch you must integrate two existing networks, modeling tools can give you the big communications picture. Some products make you get your hands dirty and fill in all the details about the components yourself, while others, using "automatic discovery," quiz the myriad components and construct a model for you.

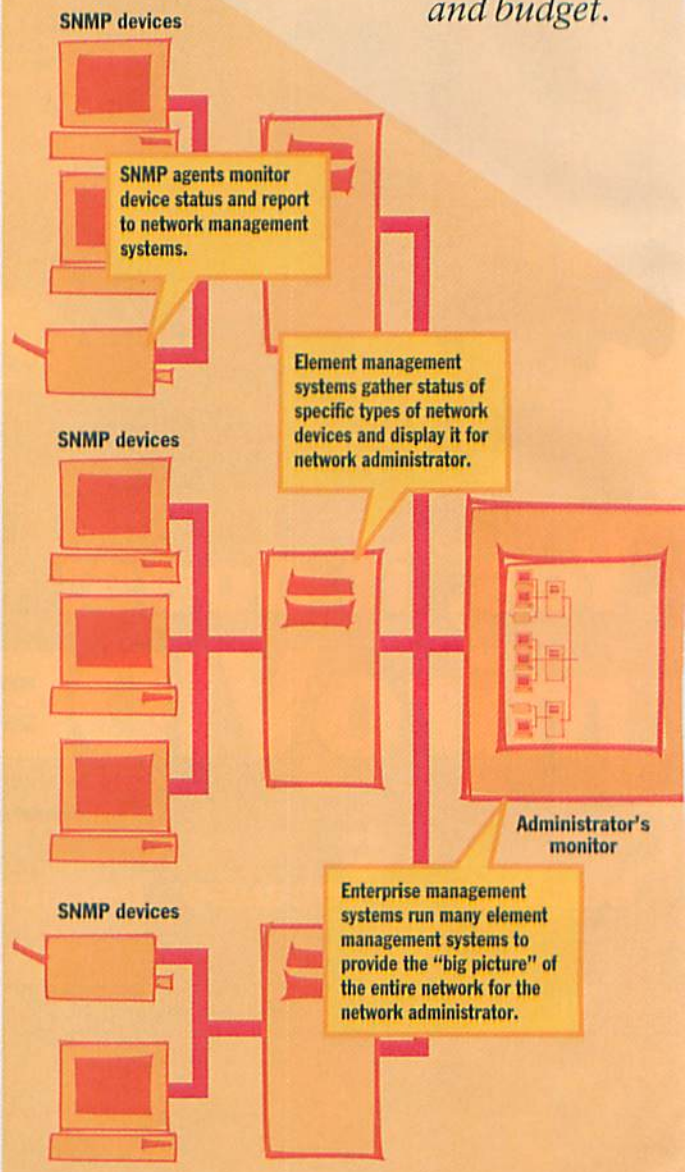
With so many interconnected components to watch over, maintenance might be your biggest headache. Most network-administration centers look like NASA Mission Control, with all their flickering monitors, each tuned to specific hardware components. Enterprise management systems can reduce the number of monitors you have to stare at each day, and they also consolidate information that logically belongs together. Event-correlation capabilities can even figure out automatically that, yes, it *was* that iffy router on the thirteenth floor that just triggered the 42 irate calls the help desk just fielded.

The harried system administrator is no longer alone in the battle to keep a company's information electrons flowing efficiently. And that can bring some quality to the business of handling all that quantity.

–Edmund X. DeJesus

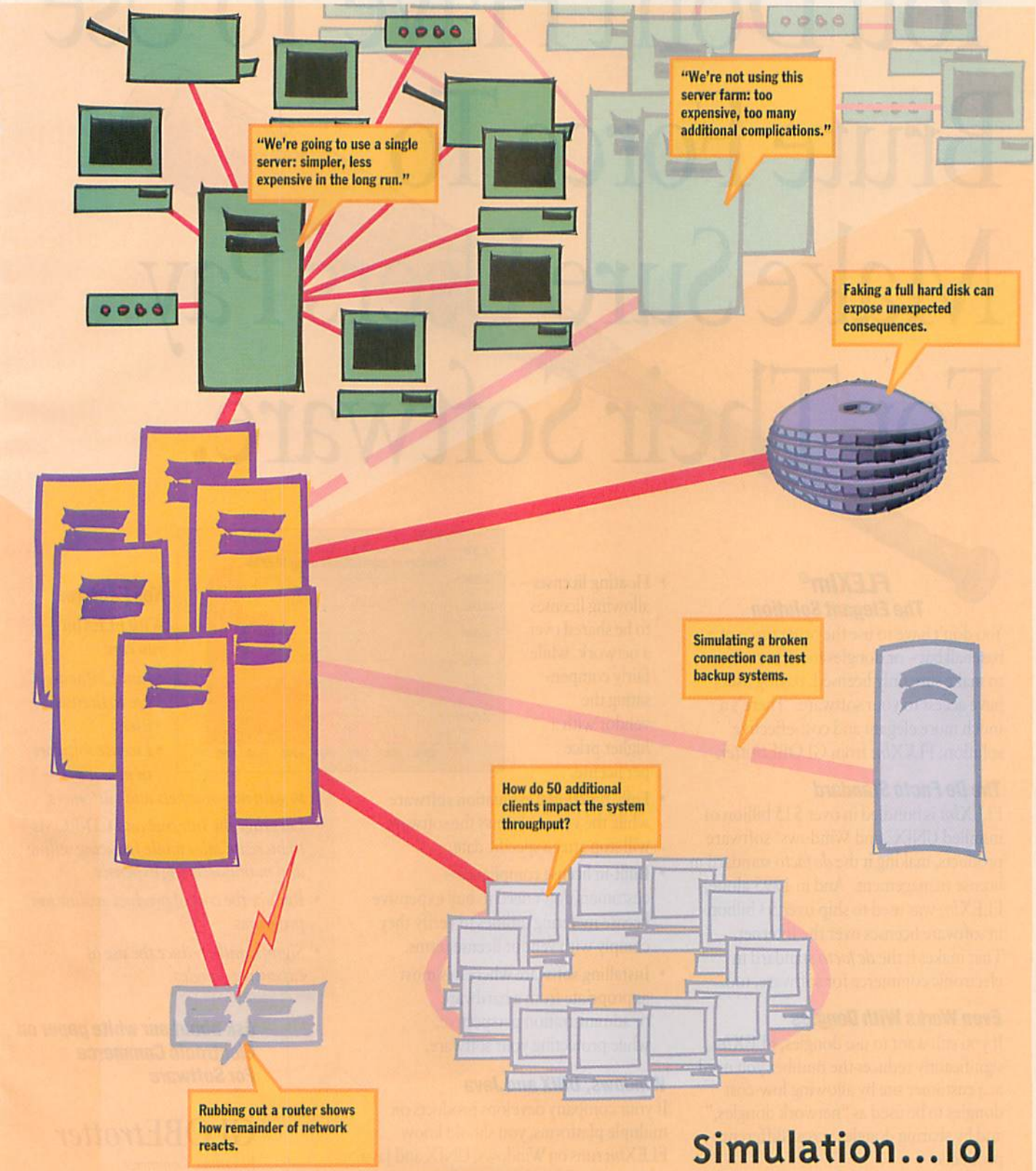
Design...93

Designing or changing large networks with graphical tools can produce viable plans that meet your goals of performance, compatibility, and budget.



Maintenance...107

Network management is simpler with devices that report their own status and with systems that consolidate and simplify the presentation of network status.



Simulation...101

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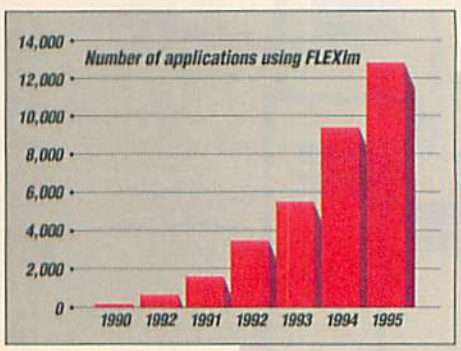

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Forget pencil and paper: Today's intelligent tools do the design work for you. By Nathan J. Muller

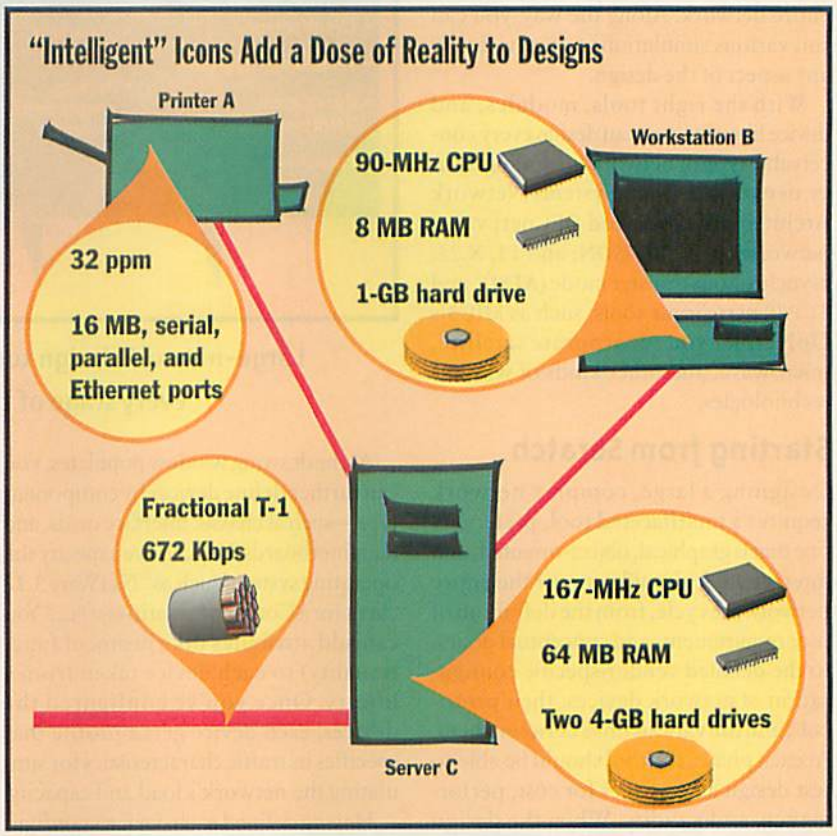
Design and Conquer

Experience tells us that a properly designed network can help an organization improve customer service, pursue new business opportunities, and respond faster to market forces. But large networks, often supporting tens of thousands of users worldwide, present special design challenges. Typically, such behemoths consist of a dizzying array of transmission facilities, LAN technologies, protocols, and standards—all cobbled together to meet the differing needs of workgroups, departments, branch offices, divisions, subsidiaries, and, increasingly, strategic partners, suppliers, and customers.

As if this complexity were not enough, big networks are usually in a state of flux. Corporate requirements, technologies, and standards change over time. Carriers introduce new services. Vendors offer new and better products. With continual moves, adds, and changes, a company's traffic patterns begin to shift. Before you know it, applications are gasping for bandwidth, response time slows to a crawl, and frustrated users start looking steely-eyed at the network administrator.

Hidden costs associated with poor network designs include overspending on equipment and WAN links to ensure sufficient capacity, trouble reports, poor response to network problems, unpredictable delays in meeting work schedules, and high labor costs for frequent rush jobs.

Fortunately, automated tools are available to help you head off these sorts of problems at the pass. With built-in intelligence, these tools take an active part in the design process (see "Design's Four Stages" on page 94). With the type of software we'll discuss in this article, you can build a computerized model of a network; validate its design and gauge its performance; quantify equipment requirements; and explore reliability and security issues before you purchase a single network component. Some of these tools may even identify faulty equipment configurations, design flaws, and standards violations.



With some network design tools, hardware icons contain configuration information about the components they represent.

Network Designer Tools

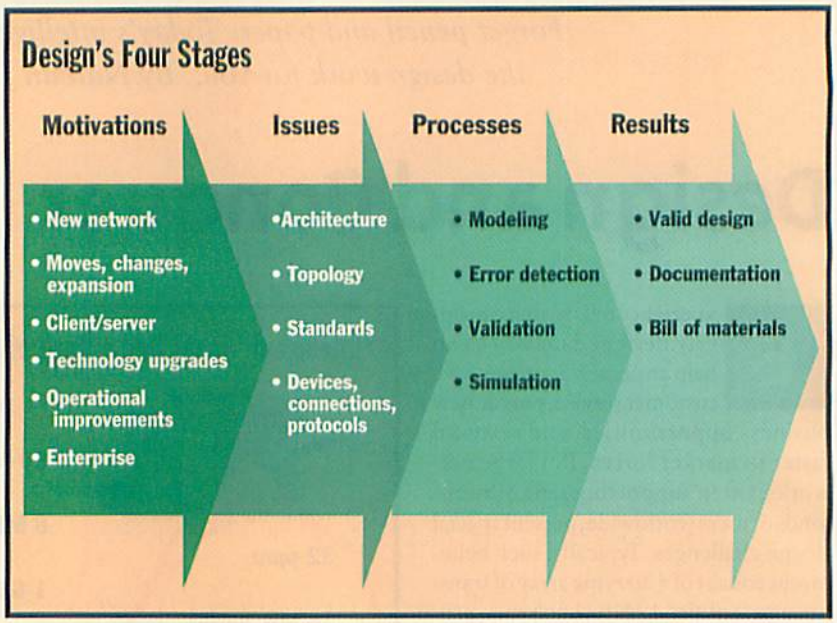
Because of the size of the network designs they handle, these tools typically run on Windows NT, Unix, and SunOS. There are two notable exceptions: Supporting Windows 95 (as well as Windows 3.1) are Network Design and Analysis's AutoNet, a program for designing T-carrier networks, and American Hytech's NetGuru, for designing LANs and networks of unlimited size.

At the low end, prices for design tools begin at $495 (for NetGuru). At the high end, prices range from $5000 for Image-Net's CANE (Computer Aided Network Engineering) to $15,000 or more for MIL 3's OpNet and Make Systems' NetMaker XA, depending on the type and number of optional plug-in modules. For companies that do not have the time or expertise to learn and use these tools themselves, some vendors, such as Make Systems, offer outsourcing services based on their software; cost of such services starts at $1750 a day.

When working with these tools, you begin the build-a-network process by opening a blank drawing window, into which you can drag various vendor-specific devices—workstations, servers, hubs, routers—from a product library and drop them into place (see the screen

on page 96). You can further define the devices by component type, software, and protocols, as appropriate. Lines link the devices to form a network, and each link gets assigned physical and logical attributes. Rapid prototyping provides the ability to copy objects—devices, LAN segments, network nodes, and subnets—from one drawing to the next, editing as necessary, until you have built the entire network. Along the way, you can run various simulations to test virtually any aspect of the design.

With the right tools, modules, and device libraries, you can design every conceivable type of network, including legacy networks such as Systems Network Architecture (SNA) and DECnet; voice networks including ISDN; and T1, X.25, asynchronous transfer mode (ATM), and TCP/IP nets. Some tools, such as MIL 3's OpNet, let you incorporate satellite, microwave, and other kinds of wireless technologies.



Large-network design tools can improve and simplify every stage of the design process.

Starting from Scratch

Designing a large, complex network requires a multifaceted tool, preferably one that is graphical, object-oriented, and interactive. It should support the entire network life cycle, from the definition of user requirements and conceptual design to the detailed vendor-specific configuration of network devices, their protocols, and the various links between them. At each phase, the tool should be able to test design alternatives for cost, performance, and validity. When the design checks out, the tool should spew out network diagrams and a bill of materials. All this happens before you contact a single equipment vendor or carrier sales rep or write an RFP.

For administrators embroiled in the complexities of network design, this kind of tool represents a dream come true. ImageNet's prerelease version of CANE, an integrated set of Windows NT applications, comes close to meeting this ideal. Designers can take a top-down or a bottom-up approach to network construction. In the top-down approach, the designer starts by sketching out the overall network, then adds increasing levels of detail until every aspect of the network is eventually fleshed out. The bottom-up approach might start with a LAN in a specific department to which you link subsequent drawings to create the overall network structure.

As the drawing window populates, you can further define devices by component type—such as chassis, interface cards, and daughterboards. You can even specify the operating system, such as "NetWare 3.12 client for a Compaq Presario 660 PC." You can add attributes (like protocol functionality) to each device taken from a library. Once you've configured the devices, each device gets a profile that specifies its traffic characteristics for simulating the network's load and capacity.

Having defined each device's configuration, lines between them form the network. CANE then validates the links, testing for common protocols and network functions. This prevents obvious mistakes, such as NetWare clients connecting to other clients instead of servers, for example. This on-line analysis feature also alerts the designer to undefined links, unconnected devices, insufficient available ports in a device, and incorrect addresses in IP networks. An off-line analysis tool reports violations of network integrity and proper network design practices. The designer can analyze the network's structure, its IP completeness, or both at once.

CANE simulates the completed network, using a database that describes how actual network devices behave under various real-world conditions. The simulator generates network events over time, based on the device and traffic pattern recorded in the simulation profile. The designer can test the network's capacity under various "what if" scenarios and fine-tune the network for optimal cost and performance. Simulation in the prerelease version of CANE operates on one LAN segment at a time. By the time you read this, the commercial version of CANE will support fully integrated enterprisewide LAN and WAN simulation.

Better Designs, the "Primitive" Way

The Make Systems design package focuses on building WANs. Among the company's set of six core tools in NetMaker XA is the Designer module. Designer allows you to build cost-effective topology and clocking designs—from the ground up or incrementally—using a library of building-block "primitives."

With the time-division multiplexing (TDM) primitives library, for example, you can build an entire T1 network within your specified parameters and constraints. You can strive for the lowest transmission cost that supports all traffic, for instance, or for line redundancy between all the TDM nodes. Each primitive addresses a different aspect of the design. You can run tail circuit design, hub selection, or redundancy primitives as needed. You can combine them to address the overall design objectives. You can pause the design process after each design

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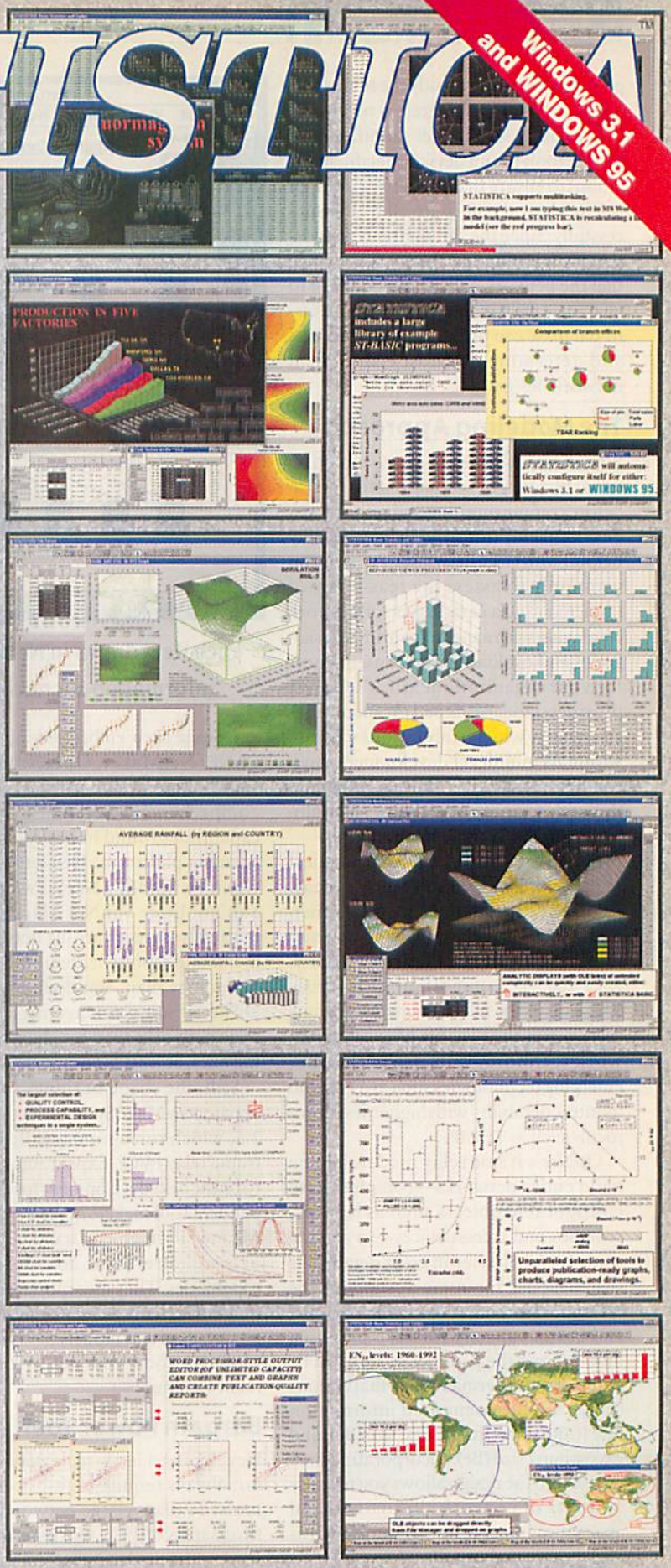

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primitive executes to study the results and adjust network parameters if necessary.

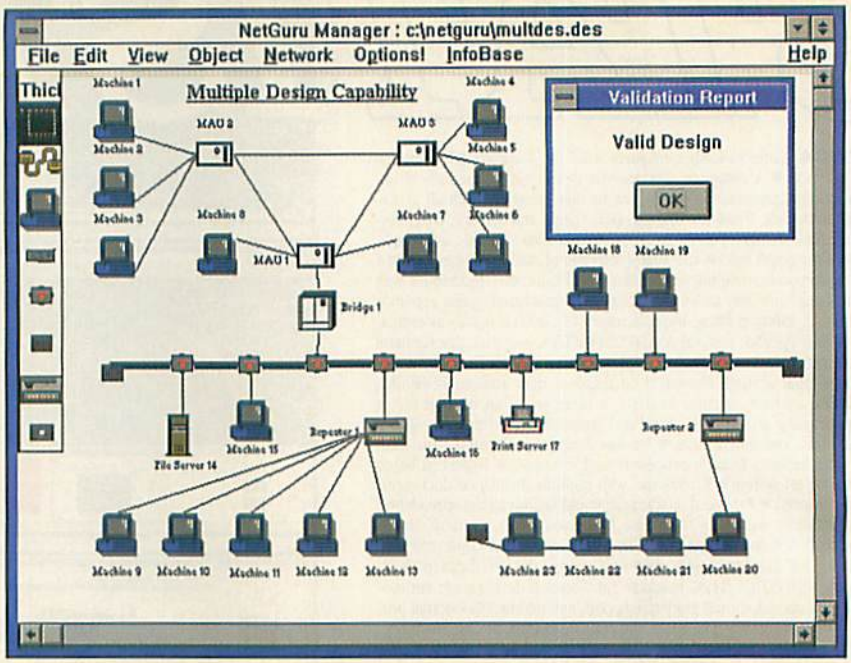
Designer uses Planner (another NetMaker tool) to run device-specific simulations to ensure that the network design is feasible and will route all traffic successfully. Since the simulation is vendor-specific (via plug-ins) there is less chance that the network will be overbuilt just to guarantee the handling of all traffic. A tariff database can price transmission links and determine the most economical network design.

The Modeling Approach

Sometimes it's best to approach unfamiliar territory by scoping out the terrain before committing time and resources to development; this strategy is especially helpful with large networks. Perhaps you want only to assess the feasibility of implementing a certain type of network by playing with a model's various design issues and evaluating the consequences for your organization. MIL 3's OpNet provides standards-based protocol models against which simulations can run within its multilevel development environment. Its model libraries let you do this with a variety of network technologies including frame relay and ATM.

Frame relay, with efficient statistical multiplexing of data and low overhead, has gained broad acceptance in large networks. As frame relay supplements—and replaces—legacy technologies such as X.25 and TDM, important issues arise. These issues include the benefits of frame relay versus the benefits of existing network technology, its use with other emerging technologies such as ATM, and its interoperability with higher-level protocols such as TCP/IP.

OpNet's frame relay models let you build entire networks—complete with configurable objects such as routers, switches, and access devices—so you can study their behavior in great detail. The switch model, for instance, supports the creation of routing tables, switching rate, and buffer capacity for each outgoing link. Among the parameters that can be applied to the permanent virtual circuits (PVCs) are the committed information rate (CIR), committed burst size (Bc), and excess burst size (Be). Incorporating such details into the design allows you to study a variety of network alternatives and assess the impact of new features such as switched virtual circuits (SVCs).



Each item drawn in NetGuru is an intelligent icon that references information for network design, validation, and simulation.

Despite their embedded intelligence, CANE, NetMaker, OpNet, and other stand-alone design products lack the comprehensive automatic discovery capabilities found in heavy-duty management platforms. Hewlett-Packard's OpenView, IBM's NetView/6000, and Sun's Solstice SunNet Manager automatically detect various network elements and represent them with icons on a topology map. Stand-alone products are better suited for creating new large-scale networks than for changing existing ones, at least for now.

Still, the shape of things to come is apparent in Make System's NetMaker XA 2.5, which can automatically discover frame relay PVCs. Expect autodiscovery to be the next development focus of independent tool makers in the coming year. Meanwhile, high-end stand-alone products still offer more advanced design capabilities. They incorporate a broader range of network technologies and equipment makes and models than the design tools that come with network management systems.

Bargain Power Tool

Developing a large-scale network does not always require high-priced design tools. To plan a large network that has thousands of PCs, workstations, and servers attached to hubs—interconnected via bridges or routers over IP networks—you could, for example, use American Hytech's NetGuru, a $495 package that runs under Windows 3.x.

NetGuru allows network professionals to design, validate, and document LANs of any size, including ARCnets (see the screen above). It validates a network design based on standards—or de facto standards—with an internal rule-checking knowledge base that you can invoke at any time. The validation ensures that all network components are accounted for—including network interface cards, converters, terminators, transceivers, multistation access units (MAUs), bridges, repeaters, routers, hubs, and different cable types—before you start building a network or making additions to one. If a device is misconfigured or a 10Base-T wire exceeds the IEEE standard length, for example, NetGuru alerts you. For the truly adventurous, the program has an expert mode that allows experienced designers to override standards and push the envelope.

NetGuru can be used to design only LANs and large-scale IP networks—not WANs that include TDM, frame relay, ATM, or wireless technologies. Nevertheless, the program has many features of higher-priced packages, including object orientation and device libraries, drag-and-drop component assembly,

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simulation capabilities, network documentation, and bill of materials support. An advanced Boolean search engine helps you locate any database element.

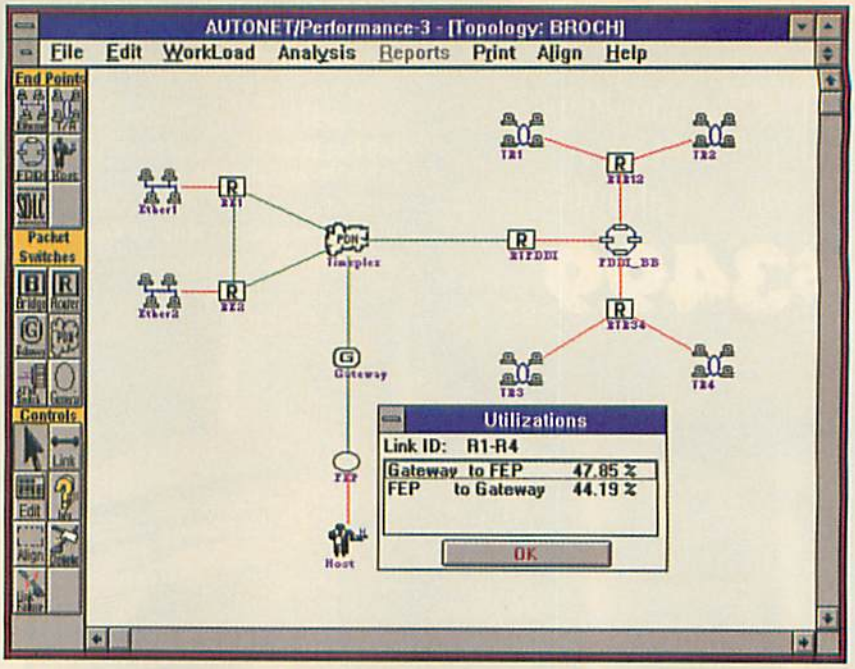
Web-Accessible Tools

The Web, besides extending help desk support, configuring and monitoring network devices, accessing network performance data, and enabling and disabling device operations, can also assist with network design.

NetSuite development tools help network professionals design and draw a mammoth network and publish their designs on the corporate intranet or the public Internet. Any authorized user can view them with a Web browser. NetSuite DesignView converts network designs and device details developed in NetSuite Professional Design into hyperlinked Hypertext Markup Language (HTML) documents with device configurations, port usage, and even device photographs. Users can easily navigate from device to device to trace connectivity and review device configurations. Besides supporting fault identification, the hyperlinked documents can be useful when you have to plan design changes.

Achieving specific design objectives requires properly configured equipment at each node. Calico Technology provides a product configurator that interconnect vendors can use to help their systems engineers, value-added resellers, and large customers accurately configure complex, built-to-order products such as routers and hubs.

Cabletron and Cisco are two of the companies that use the Calico Configurator. For example, authorized users can access Cisco's Configurator Agent page on the Web, search for configurable products, choose a particular model, and configure it. A Cisco 7000 backbone router, for example, can be configured for software options, power supply, power cables, memory, route and switch processors, and interface modules. Error messages flash on screen to indicate if you've picked a particular equipment configuration that's invalid, and suggestions help you pick the best configuration. The controls on the page allow you to then send the order to Cisco.



Network Design and Analysis's AutoNet/Performance-3 offers simple graphical design tools and analysis functions.

Not Quite Rome in a Day

In simpler days, network gurus kept information systems and networks operating smoothly with all configuration details tucked away in their gray matter. Today, systems are distributed and networks are going global. With intelligent hubs, switched LANs, sprawling router networks, broadband facilities, and advanced services like frame relay and ATM in the mix, large-scale networks are beyond mere human comprehension.

A new generation of intelligent design tools with built-in error detection, simulation and analysis, and plug-in function modules, has finally arrived. Managers and planners needn't be intimately familiar with every aspect of their networks. You can retrieve essential information instantly—often with point-and-click ease—then analyze, query, manipulate, and reanalyze that information if necessary. You can display the results in easy-to-understand graphics or export it for further study. Since products differ in the type and scope of data they provide, tools from different vendors may be necessary. Ultimately, the quality and completeness of the data determine the optimal network design.

With these powerful and intelligent new network design tools, you still may not be able to build Rome in a day. But you at least have a chance to build a solid foundation. B

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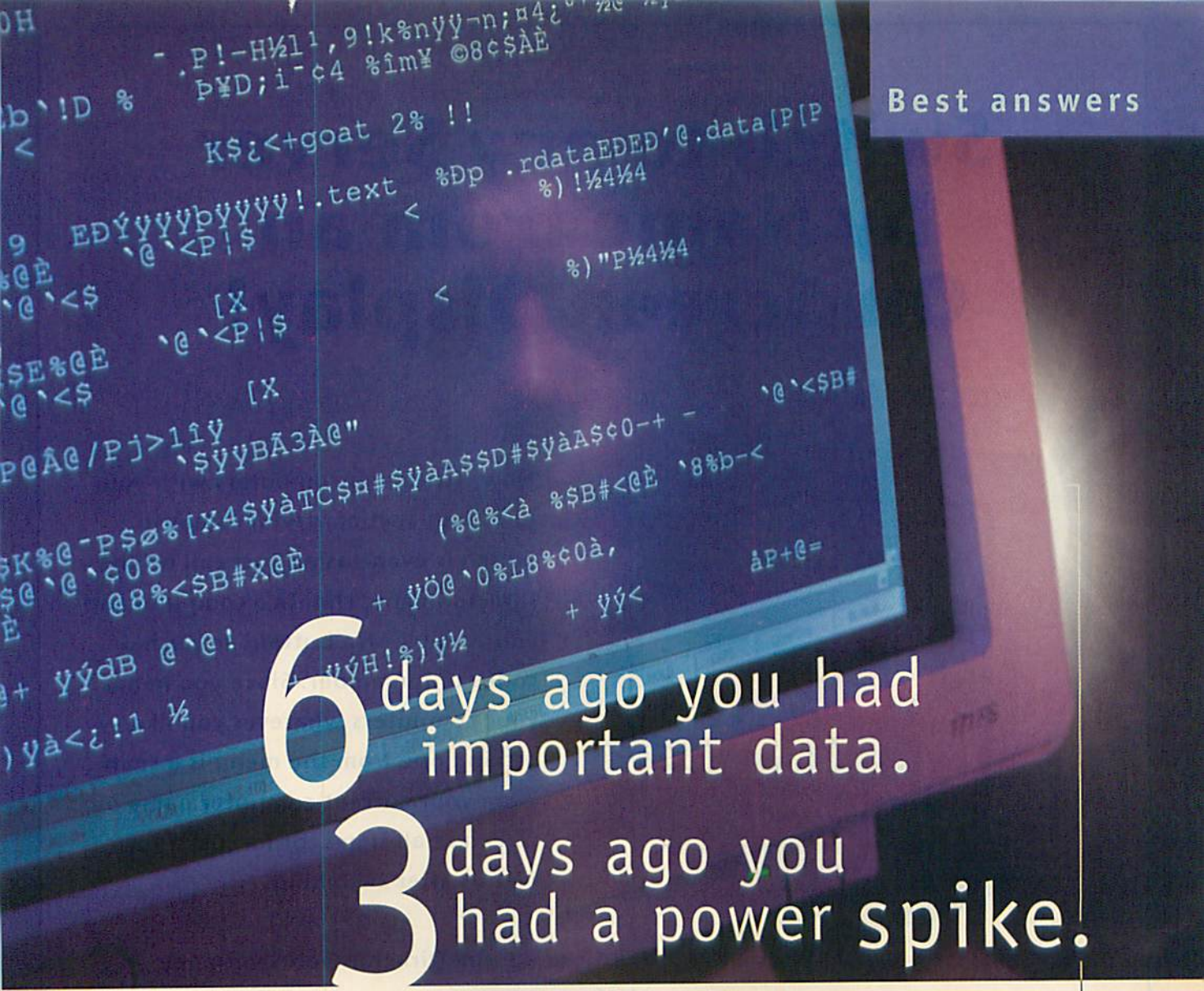
Nathan J. Muller, based in Huntsville, Alabama, writes extensively about computers, communications, and management. Among his latest books is Network Planning, Procurement & Management, *published by McGraw-Hill. You can reach him by sending e-mail to* **nmuller@ddx.com.**



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Dealer Program Available

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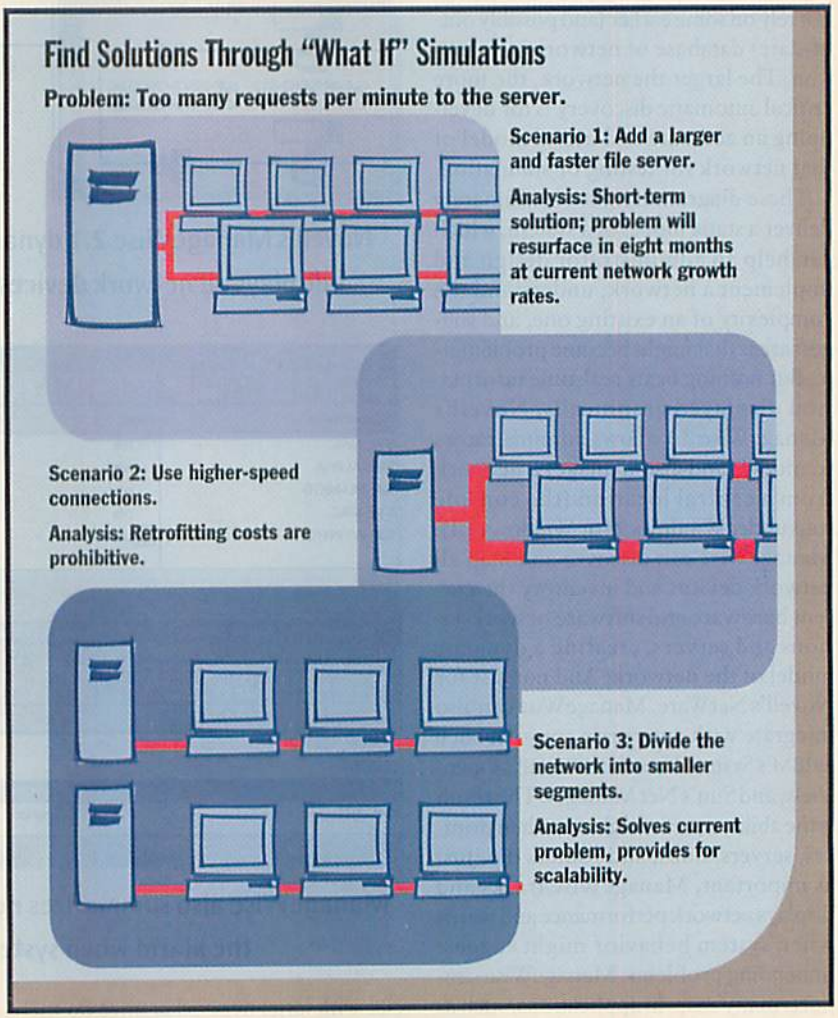
Commercial tools help system administrators manage traffic jams and avoid downtime. By Charles D. Knutson

Building the Model Network

How do you efficiently design, build, grow, and manage huge networks without being able to automatically model and simulate them? Answer: not very easily.

Modeling is based on the existing large network. A good model can show you nooks and crannies, and their technical features, where you never even knew you had nooks and crannies. Modeling captures the network in a static or a dynamic snapshot for further analysis. What kind of analysis? Let's say you're considering new topologies. You might want one clear diagram of your until-now ad hoc accretion of network segments. You will probably also want to test aspects of network capabilities: Testing exercises network components to find their limits.

Simulation uses the network as a base, then goes off into the what-if world that's essential for planning. Naturally, designing large networks (see "Design and Conquer" on page 93) involves simulation, and maintaining networks (see "See the Big Picture" on page 107) involves testing. System administrators are in the tricky position of trying to satisfy everyone on their big network. Here are some automation tools that can help administrators deliver satisfaction.



One of the most valuable things about simulation tools is they let you try out different "what if" solutions to network problems.

Good Models Make Good Networks

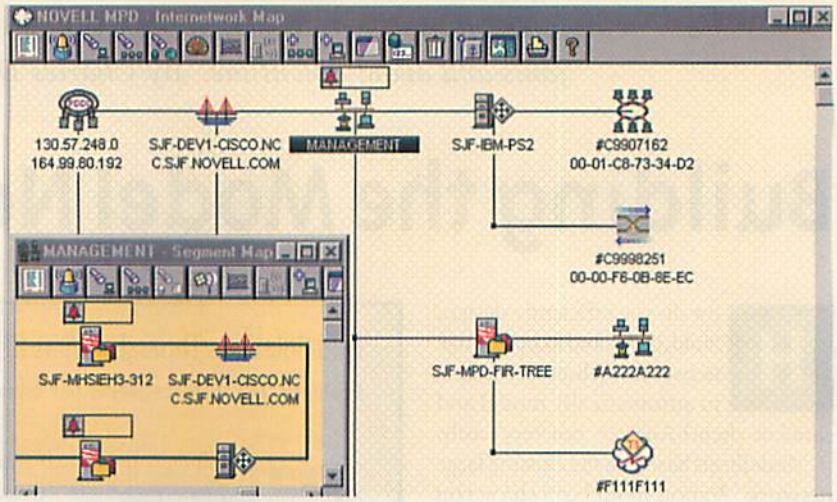
To manage a complex network and avoid system degradation and downtime, it's critical to have a view—a model—of what the network looks like. When big nets go down or slow down, companies lose big money. That's where a good model comes in. Like a road map when you're hopelessly lost and late, a detailed network model can simplify and speed solving network hang-ups. Without a detailed network model? You could be hosed before you know what hit you. As Bob Ross, president of LAN Utilities (Pleasant Grove, UT), developers of LAN test tools, says, "The self-perception of administrators is that they deal with problems within 20 minutes, but that's only after they find out about them."

Luckily, there are tools that can help create detailed and useful models of even the most arcane and far-flung nets. PinPoint Software continues to improve ClickNet, its network-diagramming product that allows administrators to customize graphic views of a network. It interfaces with network management packages (including Seagate's LAN Directory for Windows and McAfee's Saber LAN Workstation), can download information (about cable configurations; types of workstations, servers, hubs, and routers; and mission-critical software packages), and can automatically generate a graphic model of the network.

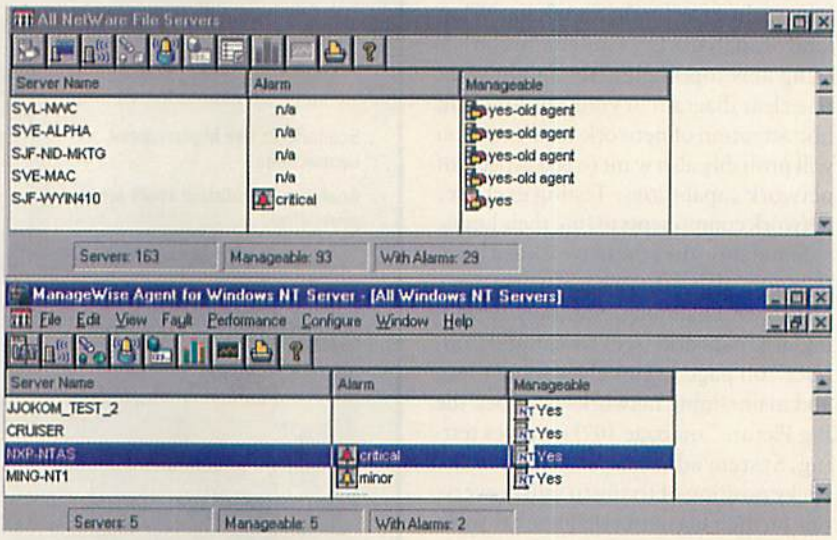
While Visio's Visio Technical 4.0 and Visio Shapes for Network Equipment may provide more powerful drawing capabilities—drag-and-drop diagramming, clean interface, and ease in aligning and moving objects without breaking

connections—they can't directly import information from network management packages. One of the more impressive and intelligent network-diagramming tools is Quyen Systems' netViz. Besides powerful drawing capabilities, netViz automatically discovers and displays information about nodes on a Novell network, identifying servers, workstations, and volumes. Automatic discovery does not rely on some earlier (and possibly out-of-date) database of network information. The larger the network, the more critical automatic discovery is for developing an accurate and useful model of that network for testing or simulation.

These diagramming tools ultimately deliver a static model of a system, which can help an administrator design and implement a network, understand the complexity of an existing one, and suggest areas that might become problematic. But nothing beats real-time information displayed graphically. Novell's ManageWise 2.1 allows administrators to model (and also manage) a network from a central location (the console runs under Windows 95 or Windows 3.1). ManageWise can discover and map all network devices and inventory the current hardware and software of workstations and servers, creating a dynamic model of the network. And not just for Novell's NetWare. ManageWise can also integrate with enterprise consoles such as IBM's System View for AIX, HP's OpenView, and Sun's Net Manager. The result is the ability to see at a glance when printers, servers, hubs, and routers die. Just as important, ManageWise tracks and displays network performance and warns when system behavior might suggest impending problems. ManageWise supports many snap-in applications, such as DenMac's Alert Pager, which immediately informs net supervisors of problems. That means an administrator on the golf course can receive a pager message with the news that a key server has died—unpleasant as golf rounds go but essential for limiting network downtime.



Novell's ManageWise 2.1 dynamically discovers and graphically displays all network devices for modeling and managing.



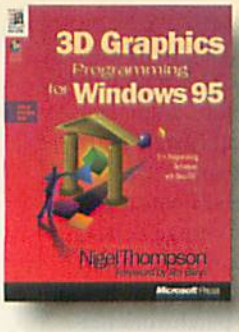
ManageWise also summarizes network configurations and sounds the alarm when system behavior goes awry.

Good Simulation Means Better Testing

A network simulation builds on a model, then brings it to life. Like a model train layout, a network simulation gets all the make-believe traffic moving, all the imitation lights blinking, and all the artificial crack-ups resulting. This is especially crucial with large networks, since no mere mortal can keep the whole conglomeration straight in his or her mind. With a good simulation, you can spot bottlenecks, buildups, and backups. Simulation is also a valuable basis for testing, since you can try things out on the simulator before flying the real fighter jet.

Unleashing new applications or new changes on an unsuspecting large-scale network can be disastrous. Developers especially face this problem. "That's one thing I've definitely found," says Ross. "In a development environment, usually you're fairly sequestered. It's usually not that busy of a network. So the engineers typically are developing on this quiet net, and then you throw the software onto a production environment and it goes berserk." New applications may also face mysterious and temperamental real-time problems—sneaky bugs that appear only at certain times of the day or under certain kinds of traffic loads. The hardest part of crushing these bugs is recreating them. To do that, the system administrator has to be able to replicate not just traffic volume but particular kinds of traffic.

So how do you adequately test a client/server application product that has never seen a really ugly network? Build your own ugly network! Chariot, from Ganymede Software, is a tool that can



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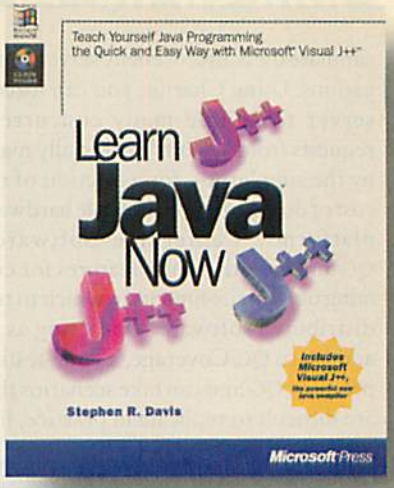

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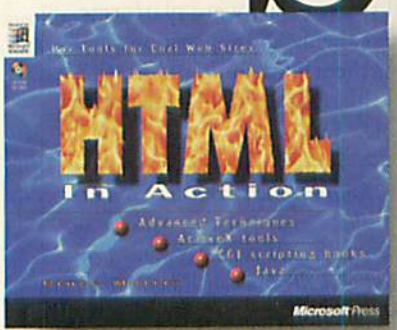

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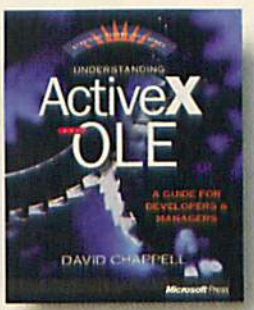

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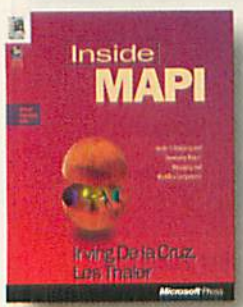

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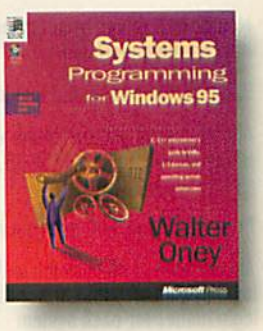

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simulate the traffic of client/server applications. Using Chariot, you can force a server to handle many concurrent requests from "clients" artificially made by the simulator—for a fraction of the cost of doing it live on multiple hardware platforms. CenterLine Software's QC/Sim has other nifty features for creating ugly environments in which to test distributed software. Operating as an add-on to QC/Coverage, a code-testing product, QC/Sim can fake scenarios that are difficult to replicate in practice, like network failures, limited disk capacity, and other real-life horror stories.

Bringing It All Together

In an ideal world, you would buy your whole network from a single vendor, with one perfect modeling and simulation product. But in reality, your huge network has probably snowballed until it seems to have a life of its own. "Larger organizations with multiple deployed offices don't go to Ford and buy," observes Bill Gillman, vice president of operations at Gentner Communications Corp. (Salt Lake City, UT), a manufacturer of telecommunications equipment. "They go to the store and pick some NAPA parts and some GM parts and some Ford parts, and they build their own custom car." As a result, the average system administrator has a nearly impossible task. You need a product that can, first, create a model of your patchwork network and, second, let you simulate what-ifs to that network. So what do you do?

You must zealously identify the tools that can grasp your network's complexities, then assemble those tools into a system that works. Large networks are built out of disparate hardware platforms, operating systems, and applications, and managing them is a daunting adventure. Without the right tools, it's downright impossible. B

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Charles D. Knutson owns ComSoft Consulting in Corvallis, Oregon. In a previous life he was a system test manager for NetWare Client Products at Novell. You can e-mail him at **cknutson@csconsult.com.**

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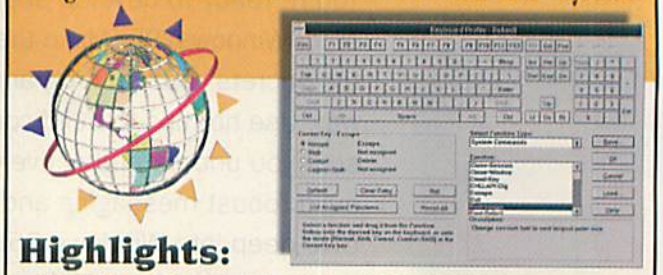

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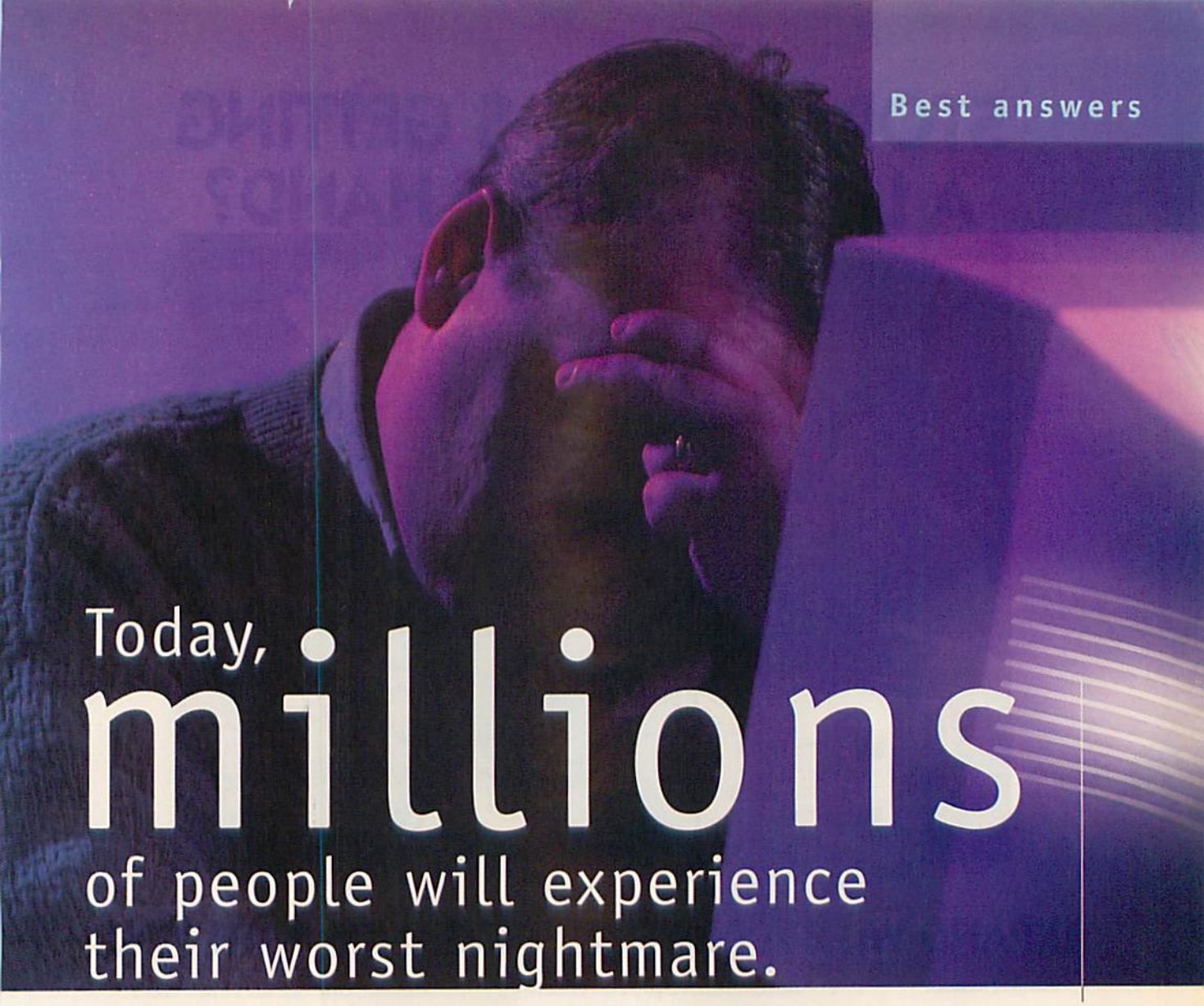

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Circle 180 on Inquiry Card.

Tracking thousands of users—and the related troubleshooting—can be made simpler with the right tools. **By Tim Wilson**

See the Big Picture

If you manage a large network, your job description is simple: Keep your organization's network up and running 24 hours a day, seven days a week, preferably at peak performance. Do a good job, and no one even knows you're there. But if the network crashes, it could cost your organization thousands, even millions, of dollars in lost business and productivity. And you could lose your job. (Gulp!) The task is much like piloting an airplane: hours of boredom punctuated by moments of sheer terror.

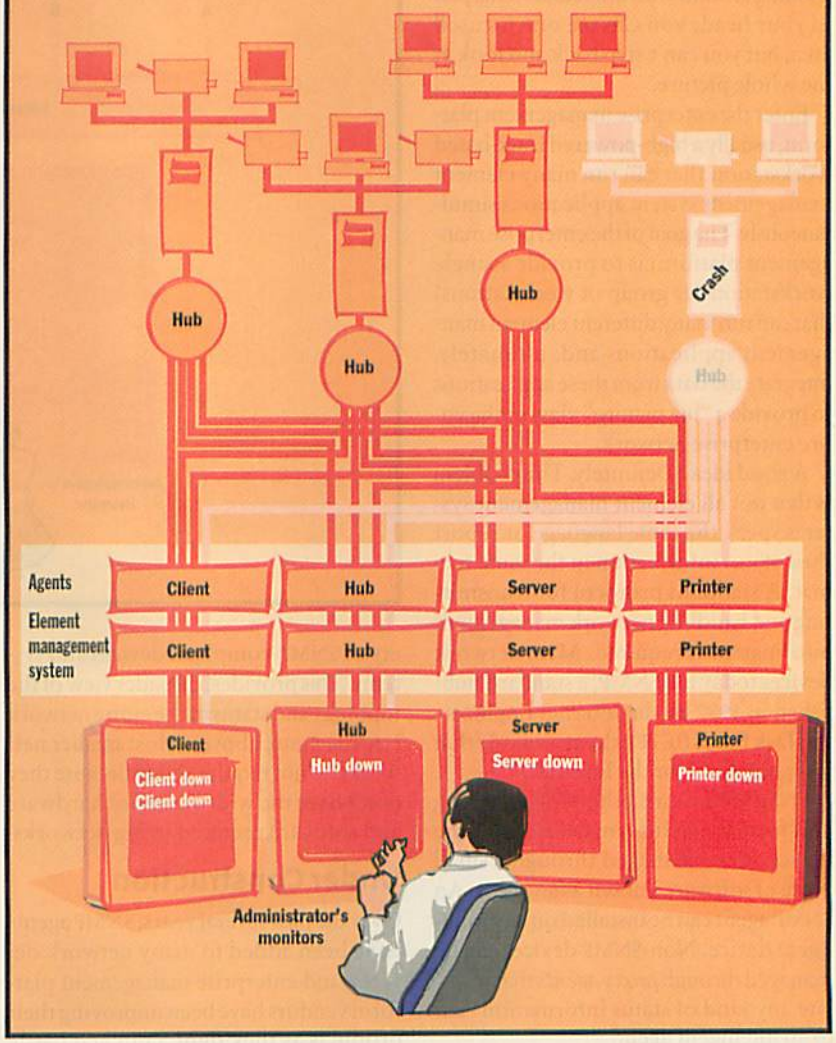
You can boil down your job description to a simple axiom: Uptime good, crash bad. That sounds simple enough. It's actually not too much different from managing a 10-node LAN, except that you can't use Norton Administrator to troubleshoot a 20,000-node network that spans 15 countries and includes everything from IBM mainframes to laptops and from multiprotocol routers to T1 multiplexers. For this job you need software with a little bit more power—what has now become known as an *enterprise management system*.

IBM, in the mainframe-oriented heyday of the 1980s, was the first company to develop an enterprise management system capable of monitoring and controlling networks consisting of thousands—even tens of thousands—of hosts and terminals. That software package, called NetView, opened up a new range of applications that ranks today as one of the data communications industry's hottest markets, which includes competitors from powerhouses such as Computer Associates, Digital Equipment, Hewlett-Packard, and Sun Microsystems.

This emerging range of enterprise management applications has changed significantly over the past decade, creating new capabilities that enable network administrators to monitor and control remote computers and other devices. But many managers of mega-networks, whose jobs are on the line, say the technology has not evolved rapidly enough for their liking.

Swivel-Chair Management

Many enterprise networks are managed via separate workstations that can monitor only a specific set of "elements," such as servers, routers, or LAN hubs.



Setting the Standard

The problem, MIS executives say, is that most so-called network management tools—such as Cisco's CiscoWorks and Novell's ManageWise—are designed to manage only particular devices or systems, such as routers and LANs, in the enterprise, not the entire network. These applications (collectively known as *element management systems*), which include modem, hub, and multiplexer management systems, gather data about the operating status of specific types of network devices (e.g., LAN servers, routers, and hubs) and display it on a Unix work-

station or PC monitored by the network administrator.

Element management systems typically are included with network devices, which means that the corporate network administrator who manages equipment purchased from many different vendors might have as many as 100 different consoles to monitor. This has created a need for "swivel-chair network management": the act of swiveling or rolling one's chair among many different consoles in an effort to locate the genesis of a network failure (see the figure "Swivel-Chair Management" on page 107). It's kind of like walking around with binoculars strapped to your head; you can see one focused area, but you can't step back and look at the whole picture.

Enter the enterprise management platform, usually a high-powered Unix-based workstation that can run many element management system applications simultaneously. The goal of the enterprise management platform is to provide a single workstation (or group of workstations) that can run many different element management applications and, ultimately, integrate the data from these applications to provide a "big picture" view of the entire enterprise network.

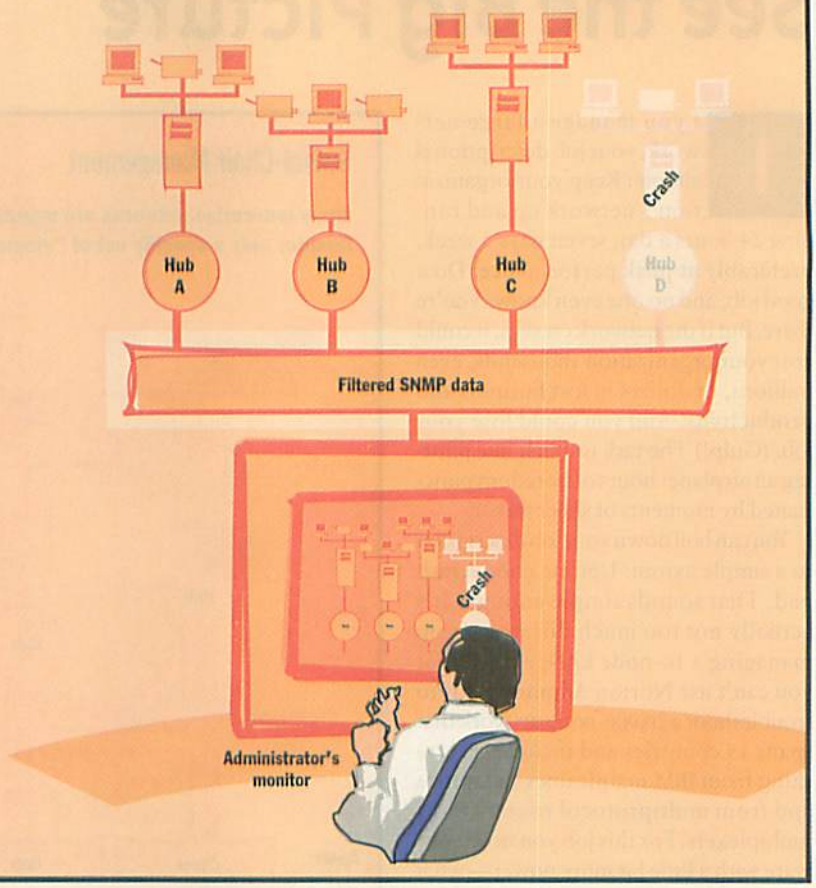
A good idea? Definitely. The problem is that not all element management systems speak the same language or report their status information in the same format. A standard protocol for transmitting and handling network management information is required. Most network devices today use SNMP, a standard published in 1992 by the Internet Engineering Task Force (IETF), the same body that sets guidelines for the Internet.

SNMP defines a method for collecting and formatting information about the devices to be managed through a small piece of software known as an *agent*. An SNMP agent can be installed on any intelligent device. Non-SNMP devices can be managed through *proxy agents* that translate any kind of status information sent to an intelligent agent.

Today, most network devices come with built-in SNMP agents that let them transmit status information to an SNMP-based management system. An administrator sitting at the console of one of the more popular SNMP-based enterprise management platforms, such as HP's OpenView and Sun's SunNet Manager, can gather and correlate data from a variety of SNMP-compliant devices and systems. This provides a broader view of the topology and status of the entire network (see the figure above). Most smaller networks do not require SNMP because they don't have the wide variety of hardware and software required in big networks.

Centralized SNMP Management

By "standardizing" on SNMP, large enterprises can build a hierarchical management system structure that lets them see the "big picture" at a central site.



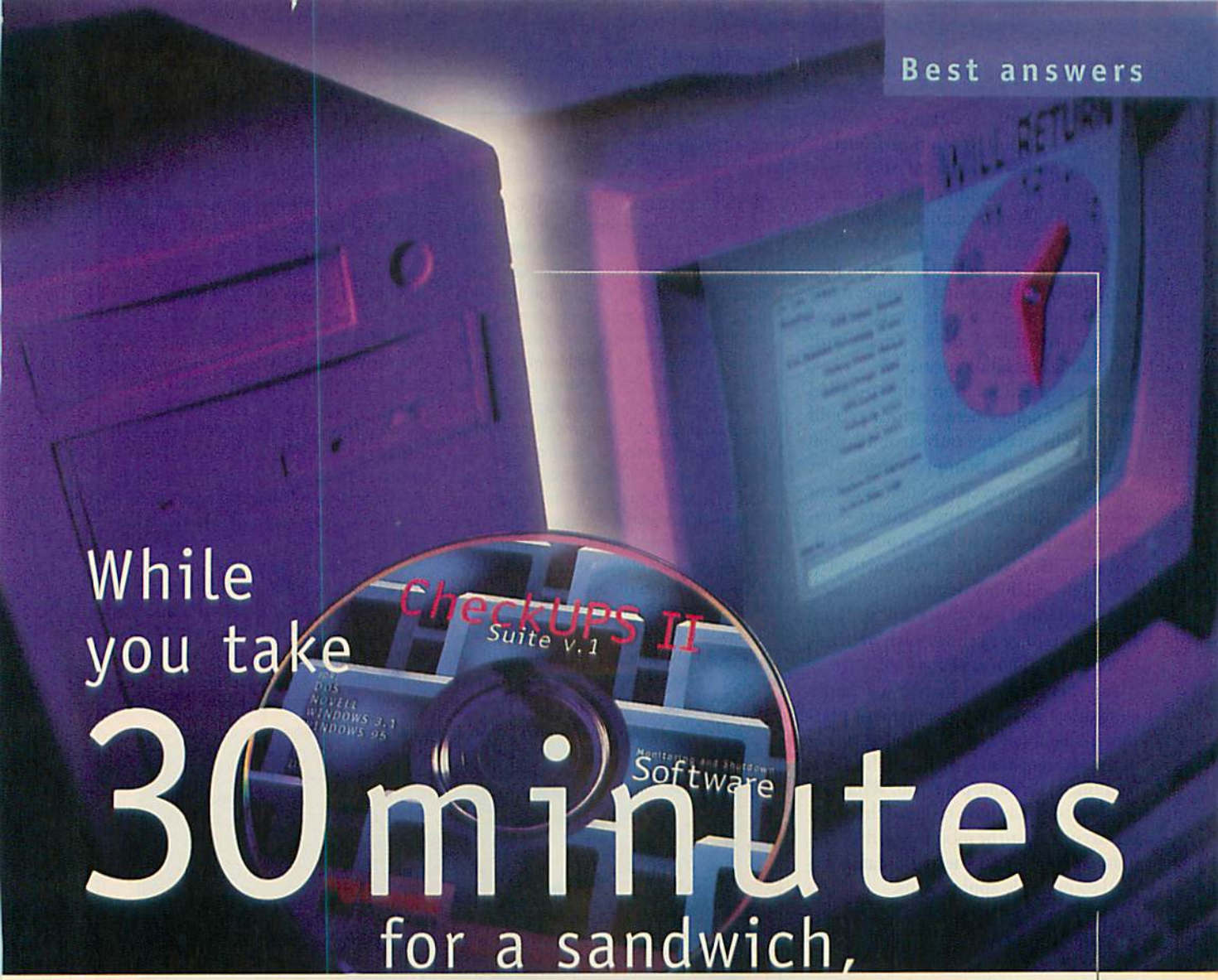
Under Construction

Over the past several years, SNMP agents have been added to many network devices, and enterprise management platform vendors have been improving their products as they fight a pitched battle for industry leadership. Yet despite these steps forward, many corporate network administrators say they're still far from their goal of developing a common set of tools for enterprise management.

One problem is that many network elements still cannot be managed by SNMP. For example, most firms haven't scrapped their mainframes, which generally employ IBM's Systems Network Architecture (SNA) protocols. These SNA networks cannot be fully monitored via SNMP, which leaves huge blind spots in the network administrator's view of the enterprise. Similar problems occur at the LAN level, where companies such as Microsoft and Novell have only recently begun to deploy SNMP in their server products.

To complicate matters, many network administrators now find themselves responsible for managing not only the corporate network but also the hardware and software at the end of each link. Increasingly, systems and applications management are tied to network management, but only network devices typically have built-in SNMP agents.

In addition, many administrators have been disappointed thus far with the lackluster performance of SNMP-based enterprise management platforms. One of the most important problems is a lack of scal-



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ability. Initial releases of several SNMP platforms—including offerings from HP, IBM, and Sun—were based on a single Unix server that couldn't share information with other management servers.

"In that world, you could see the entire environment, but only if it was small," explains Andy Vanagunas, product manager for HP OpenView. "In the larger environments, it was a little like driving with your windshield half-covered."

Under these limitations, the so-called enterprise management platforms could realistically manage only around 1000 nodes—only a slight improvement over some higher-powered LAN management systems. Although some vendors—notably Cabletron Systems, Groupe Bull, and HP—have fixed this problem to provide high scalability in current releases, many potential buyers are still stinging from the failure of those early releases to meet their high expectations.

Another deficiency in many currently available enterprise management platforms is the absence of communication between element management applications running on the same platform. While administrators may have reduced the number of consoles to be monitored, they still must correlate in their heads the data gathered by multiple applications.

For example, a router failure on a network might terminate communications with 100 systems attached downstream from that router. Sitting at the SNMP enterprise management console, the network administrator is suddenly swamped with 101 alarms that indicate a system failure. Yet only one is the cause of the problem; the other 100 are only symptoms. In many cases, it's left to the network administrator to determine which is which.

This problem has created a niche market for management software that can correlate network events and present the administrator with root-cause information. This correlation can take place in one of two ways: through filtering, which eliminates event data that's downstream from the root problem; or through true correlation, in which data from several different applications is intelligently reviewed and processed to determine the interrelationship between separate network events.

Although event correlation is still a fairly new idea, a number of related products have been on the market for several years. Seagate, for example, offers a package called NerveCenter that correlates SNMP events; other suppliers, such as Boole & Babbage, Maxm, and Objective Systems Integrators, sell products that focus on the correlation of events in non-SNMP legacy environments as well.

Sometimes the lack of data integration between management applications creates difficulties in pinpointing the origin of a network problem. For instance, the router might indicate that a problem is caused by an overflow of data from a particular server; meanwhile, the server may indicate that the problem is in the router. This situation, sometimes called *finger-pointing*, is a common complaint of enterprise management platform users.

Many enterprise management platform vendors hope to solve the finger-pointing problem by rebuilding their network management applications using object-oriented technology. This capability, which is already in development at companies such as Groupe Bull and IBM/Tivoli, will let users share data across multiple applications, in much the same way

Tornado Touches Down

The oldest and best-known Unix-based enterprise manager on the market today is Hewlett-Packard's OpenView, which was introduced in 1990. OpenView uses the industry-standard SNMP protocol to gather data from multiple network elements via many different network management applications that run on a common workstation.

In 1993, HP began working on a new version of OpenView that was designed to manage very large networks through the distributed interconnection of multiple OpenView servers. This new version, code-named Tornado, was HP's answer to OpenView's limitations. At that time, the software could manage a maximum of only about 1000 nodes.

Development problems caused the delivery of Tornado to be delayed more than a year, but last year HP shipped an initial release that expanded the system's ability to process management data as well as increase the number of operators that could work from one OpenView server. However, Tornado 1 didn't provide the distributed capabilities required in the largest corporate networks.

In March, HP unveiled the Tornado 2 release of OpenView, which offers much-expanded distributed management capabilities. Tornado 2, officially designated HP OpenView Network Node Manager 4.1, lets managers use multiple Unix workstations to gather information about networks of 10,000 nodes or more. In the fall, HP will deliver the same software on a Windows NT platform.

The new release of OpenView also includes a new management tool, called OpenView Workgroup Node Manager, which is designed to manage smaller workgroups or departmental networks. The workgroup management tool, which also runs on Unix or NT, can interface with Network Node Manager 4.1, enabling users to handle some management tasks locally without giving up the ability to pass some management information to an enterprise management platform in the central network-control center.

HP OpenView Network Node Manager 4.1 lets multiple Unix and Windows NT workstations monitor networks with thousands of nodes.

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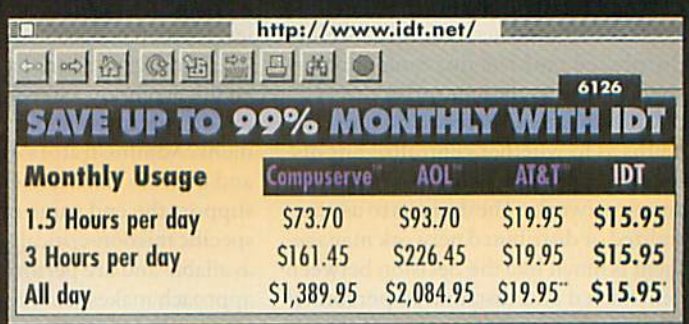

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User Approaches

Besides dealing with the deficiencies of technology and tools, corporate network managers must also face the grim reality that no two organizations, or their networks, are alike. Therefore, the method of implementing enterprise network management platforms might differ significantly from company to company.

Some firms, particularly long-established IBM mainframe shops, have a central data center that controls most of the data network management functions in the enterprise. These organizations prefer a central point of control for monitoring all network activity, such as what the mainframe-based NetView provided in past years. This allows all troubleshooting, as well as other administrative tasks, to be handled by a centralized group of people and software.

In today's client/server multivendor environment, this centralized method of control can even be applied to the use of SNMP-based enterprise management systems. The network manager might divide the enterprise into multiple management domains—based on geography, applications, or traffic type—each managed by local SNMP platforms. These local platforms would all be connected to a single, central platform that collects filtered data to create a high-level view of the entire enterprise.

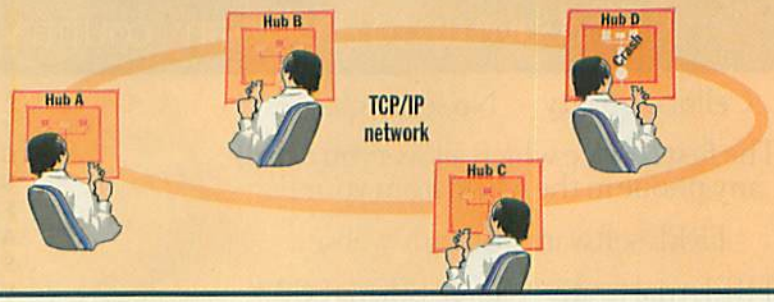
However, the proliferation of client/server technology, as well as the decentralization of many large businesses, is making centralized management increasingly difficult. In many large enterprises, network management and administration decisions are made at a departmental or business-unit level. The central MIS manager is responsible for coordinating these distributed activities—as well as distributed multivendor tools and personnel—across the enterprise.

Unfortunately, there are no universal truths as to whether centralized or distributed approaches work best in the very largest networks. The decision to use centralized or distributed network management is much like the decision between centralized and distributed personnel management; how you do it depends largely on how the organization operates.

SNMP-based enterprise management platforms were designed to function in distributed environments, collecting data in many different formats across many different domains (see the figure above). But, as previously mentioned, the lack of server-to-server communications capability in many SNMP platforms has made this approach hard to implement, since this capability is a prerequisite for scalability in very large network environments.

Distributed SNMP Management

By interconnecting all the SNMP "servers," network administrators manage pieces of a large enterprise. This approach expands the scalability of management systems and decreases reliance on a central workstation.



Whether centralized or distributed, it seems that today's enterprise management platforms have barely scratched the surface of the data they will eventually have to manage. In large organizations, the network management system is rapidly becoming the point at which the pulse is taken for the entire IS environment.

For example, many enterprise management platform vendors are adding systems management capabilities to their network management platforms. These capabilities let an administrator monitor hardware parameters, such as I/O performance, response times, and storage utilization, as well as the performance of the network. In fact, some products, such as HP's IT/OperationsCenter and IBM's SystemView, actually subordinate the network management function to a higher-level system management function.

Large organizations have recently taken this evolution a step further by focusing on enterprise applications management. Administrators employ systems and network management tools only to support the end game of ensuring that specific mission-critical applications are available and are performing well. This approach makes sense to CEOs and end users, who seldom have a great deal of knowledge of network or systems management but know when their applications are not performing as they should.

The addition of systems and applications management functions threatens to completely overwhelm today's enterprise management platforms, which have already proven to be deficient in handling network-specific data alone. How will these platforms be able to keep up?

One development that will help is the recent improvement in SNMP platform scalability. Several of the industry's leading platforms, including HP's OpenView and Cabletron's Spectrum, are now delivering server-to-server distribution capabilities that should enable them to scale to infinitely large networks. The ability of these systems to handle network and systems information—even in environments of 10,000 nodes or more—is improving significantly.

Object-oriented technology may make it easier for applications running on the same platform to share data. Companies such as IBM/Tivoli are advancing new object-oriented frameworks for building management tools; this should result in improved integration. Vendors are also integrating event correlation, rules-based reasoning, and even AI into network management systems to reduce reliance on human operation and make network administrators more productive.

Will tomorrow's enterprise management systems replace the human network administrator? Not in our lifetimes. But with new technology, administrators may be treated to a little more boredom and a lot less terror. B

Tim Wilson is a senior consultant at Decisys, Inc., an enterprise network consulting firm based in Sterling, Virginia. You can reach him at **twilson@decisys.com.**

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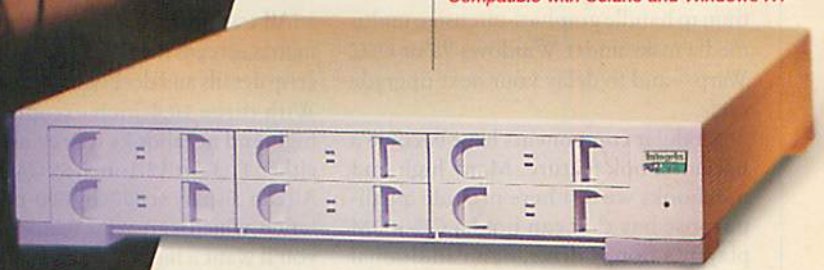

RD10 RAID Throughput Performance

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Sequential Write (max)	17.2	1247
Random Read (max)	9.9	620
Random Write (max)	13.0	357

RD10 RAID Subsystem Specifications

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Circle 139 on Inquiry Card.

19 Pentium Portables Do Multimedia

With Pentium processors, gigabytes of drive space, large screens, and CD-ROM drives, these notebooks are more than ready for prime time.

By Maggi Bender, Jim Kane, and John McDonough

When it comes to work, today's multimedia notebooks certainly let you take it with you. Running Pentium processors at rates of up to 166 MHz, today's multimedia notebooks might not be as fast as the top Pentium and Pentium Pro desktop systems, but they make good business computers, both on the road and in the office. These high-end Pentium notebooks are also expensive, being almost twice the cost of comparably configured desktop systems. However, with accelerated graphics, large active-matrix color displays, CD-ROM drives, and 810-MB or larger hard drives, they provide full-throttle computing for on-the-go professionals.

We tested 18 Pentium portables that range in price from $3000 to almost $7000 and employ 100-, 133-, or 166-MHz CPUs. We also included Canon's AMD 5x86–powered Innova Book 360CD (see the text box "AMD Inside" on page 123), which provides Pentium performance. You can buy a more economical 486DX4-based notebook, but you'll want a Pentium to handle graphics-intensive multimedia tasks under Windows 95 or OS/2 Warp—and to delay your next upgrade cycle.

Modular components have become a hot notebook feature. Many high-end notebooks we test here provide an all-purpose bay that can hold a CD-ROM player, a floppy drive, or an additional battery. You swap them in and out depending on what you need. You can't use floppy and CD-ROM drives simultaneously, but the modular design saves space, weight, and battery power while maintaining desktop functionality. We included two ultrathin systems—Digital Equipment's HiNote Ultra II and the Impulse Duonote—because they have attachable multimedia bases for CD-ROM and stereo-sound functionality, another form of modularity.

Most of the portables we tested have removable hard drives, a feature that ensures upgradability. Even the 2.1-GB hard drive in Micro-International's Mint 5200 may seem small in a year or two. Most notebooks have two Type II PC Card slots and infrared ports for cable-less file transfers. The Toshiba and NEC units implement the new 4-Mbps IrDA 1.1 infrared standard.

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NEC Versa 6030H
offers chart-topping performance, numerous portability features, and excellent ease of use.

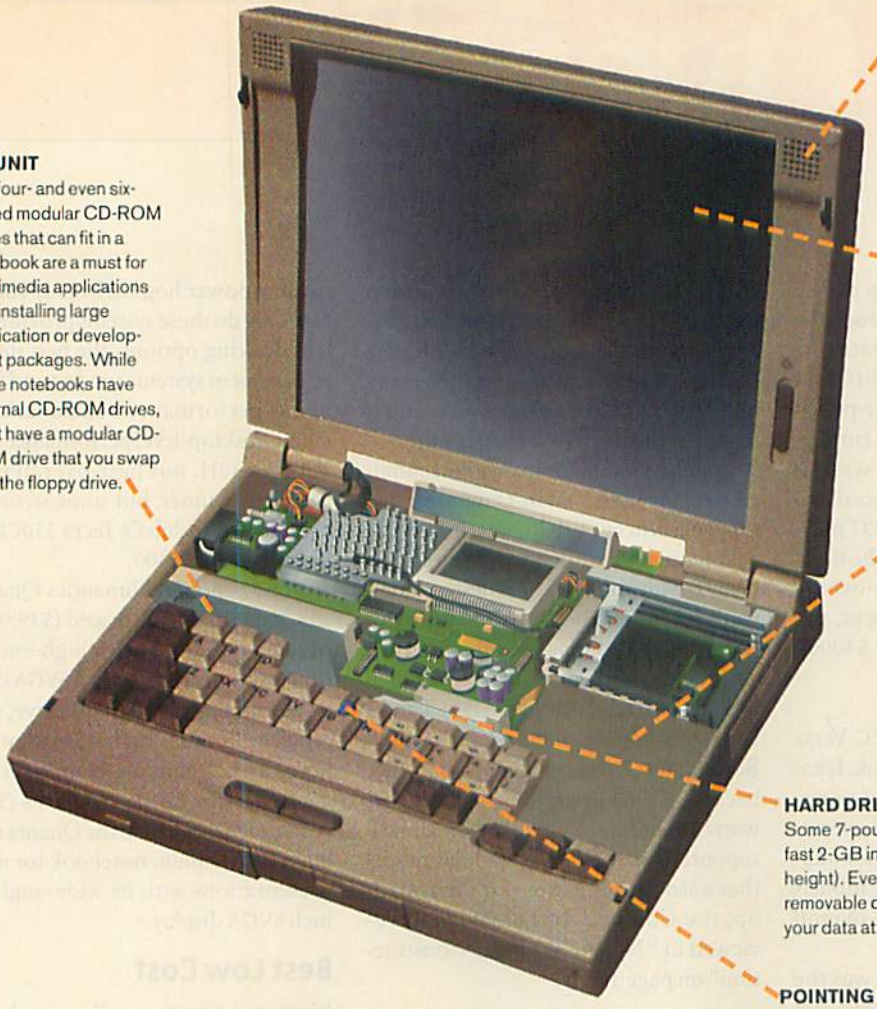
All test notebooks came with active-matrix screens that display graphics with crisp details and deeply saturated colors. With three 10.4-inch exceptions, the high-end notebooks we reviewed have either 11.3- or 12.1-inch SVGA displays. All can display at 800- by 600-pixel resolution, which is great for Windows 95, but you'll want a big display and one with a wide horizontal viewing angle if you routinely use your notebook with a handful of people sitting around a table. The 12.1-inch panels provide roughly the same viewable screen real estate as a 14-inch desktop monitor.

Less expensive passive-matrix displays are still an option with most of these products, but the trend is toward the bigger, brighter, more responsive active-matrix displays. IBM, for instance, dropped its ThinkPad 550 with the pop-open butterfly keyboard so it could add more screen real estate, and Toshiba's cutting-edge Tecra 730CDT supports an unusual 1024- by 768-pixel resolution on its 12.1-inch screen (we reviewed the Tecra 500CDT).

Those notebooks costing more than $5000 are from big-name vendors such as Compaq, Gateway 2000, IBM, and NEC Technologies. Compared to less expensive units, they come with more software and longer warranties. A unit such as IBM's ThinkPad 760ED, for instance, has multimedia luxuries: a 64-bit graphics chip with 2 MB of dual-ported video memory, hardware-assisted MPEG playback, an internal 28.8-Kbps data/fax/telephony modem, and lithium-ion batteries that outlast nickel-metal-hydride (NiMH) batteries in our battery run-down tests.

Such feature-laden portables use battery power quickly. We suggest that you get a notebook that can hold multiple lithium-ion batteries if you want to work throughout a cross-country plane flight.

The two 166-MHz notebooks we tested turned out not to be the fastest. In spite of 256-KB Level 2 caches, the Chem Book 5580 and the Micro-International Mint 5200 didn't perform as well as the 133-MHz NEC Versa 6030H. Typically, a 166-MHz Pentium system should perform 10 percent faster than a 133-MHz system. The Mint 5200 suffered from below-average memory performance and slow hard drive and CD-ROM drive speed. The



CD UNIT
The four- and even six-speed modular CD-ROM drives that can fit in a notebook are a must for multimedia applications and installing large application or development packages. While some notebooks have external CD-ROM drives, most have a modular CD-ROM drive that you swap with the floppy drive.

STEREO SPEAKERS
Though they typically don't provide the greatest sound quality, a pair of integrated stereo speakers and 16-bit Sound Blaster Pro sound are good enough for most multimedia presentations, games, and telephony.

LCDs
Multimedia notebooks with 11.3- or 12.1-inch active-matrix color displays provide crisp viewing at 800- by 600-pixel resolution. Lots of video memory and a hardware MPEG decoder help some systems display TV-quality, screen-filling video.

INTERNAL BATTERY
Most notebook vendors have made the transition from nickel-metal-hydride (NiMH) batteries to lithium-ion battery packs. Although they're costlier, lithium-ion batteries lasted longer in our battery run-down tests. They also provide more charging cycles than NiMH batteries.

HARD DRIVE
Some 7-pound computers now support a fast 2-GB internal hard drive (19-mm height). Even better, most notebooks have removable drives for upgrading or securing your data at night.

POINTING DEVICE
Everybody has a preference when it comes to pointing devices. Judging from the units we tested, touchpads and eraser-like pointing sticks are in, while trackballs are out.

IrDA INTERFACE
Infrared technology lets you transfer files to another system or send print commands without cables to IrDA-equipped printers. Most notebooks transmit at 115.2 Kbps. Toshiba's Tecra 500CDT supports the new 4-Mbps Fast-IR IrDA 1.1 specification, as does the NEC Versa 6030H.

Rear View

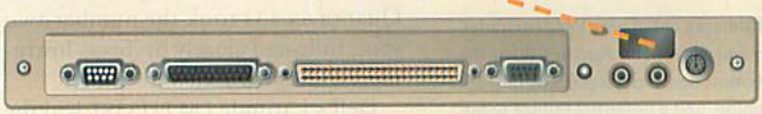


ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1996

Chem Book 5580 was hurt by poor memory and hard drive performance.

For multimedia, software development, or just to load large applications, a notebook must have a built-in CD-ROM drive. We recommend that you get one with a four- or six-speed CD-ROM drive for faster read and seek times. Multimedia notebooks must also have integrated stereo speakers, though a small speaker size limits its sound quality.

Notebooks that come with hardware-assisted MPEG—the Compaq LTE 5300, NEC Versa 6030H, Nimantics Quanta 6x 133, Impulse Duonote, and IBM ThinkPad 760ED—can effectively zoom video clips to full-screen without the dropped frames and blocky pixellation associated with software-only MPEG. Having 1 or 2 MB of dedicated video memory and a PCI-bus architecture also helps to enhance graphics I/O performance.

Toshiba's Tecra 500CDT has a Zoomed Port Video (ZPV) PC Card slot. The proposed ZPV standard establishes direct communication between the PC Card controller and the audio and video controllers, so that large amounts of multimedia data don't require processing through the CPU or system bus. When ZPV cards become widely available, the Tecra 500CDT will provide a fast connection for full-motion video playback. The Tecra 500CDT and NEC's Versa 6030H also support CardBus, another proposed standard. This standard provides for 32-bit PC Card peripherals such as Fast Ethernet and Fast SCSI adapters.

Contributors
Jim Kane, Project Manager/NSTL
John McDonough, Technical Writer/NSTL
Maggi Bender, Senior Tester/NSTL
Dave Rowell, Senior Technical Editor/BYTE

Best Overall

PENTIUM PORTABLES

Almost every desktop maker now has a portable for sale, and the market is stratifying with notebooks at different price/performance levels. Higher-priced Pentium notebooks are heavy on cutting-edge components, while value systems are capable but lack such advanced features as hardware-assisted MPEG playback. For this reason, we rated the notebooks in three categories: best-overall portable, best desktop replacement, and best low-cost notebook (under $4000).

Best Overall

We chose the well-rounded NEC Versa 6030H as the best-overall notebook. It has fast performance, a multitude of portability features, and a high ease-of-use rating. While the Versa 6030H is a hot multimedia notebook, several other models weren't far behind in our best-overall ranking.

Shadowing the Versa 6030H was the WinBook FX (our pick for best low-cost system; see below). Toshiba's 8.2-pound Tecra 500CDT also did well. The $4999 unit provides many leading-edge features, including Zoomed Port Video (ZPV) and CardBus support, as well as 4-Mbps IrDA capability. With a 120-MHz Pentium, it performed better than many units with 133-MHz processors, and it placed in the top five for battery life.

Impulse Computer may not be familiar to many users, but its Duonote made a big splash in our Lab Report. It's a moderately priced multimedia notebook ($4699) with a nice modular design. Compaq's $6398 LTE 5300 is a 7.4-pound lightweight that also placed in the top five. The highly modular system scores high in features (right behind the IBM ThinkPad 760ED and Hewlett-Packard's OmniBook 5500 CTS) and also in usability, because Compaq supplies a three-year warranty and 24-hour, toll-free technical support. (An even more modular model that wasn't ready in time for this roundup, the Compaq Armada 4100, is reviewed in "Notebook Under Construction" on page 154.)

Best Desktop Replacement

Several notebooks in this roundup beg the question: "Do I really need that desk-stealing power hog back in my cubicle?" Not only do these systems provide excellent docking options, the best desktop-replacement systems run fast and furious in our performance benchmarks, providing desktop-level performance. NEC's Versa 6030H, our best-overall pick, is again the winner, but some strong runners-up are Toshiba's Tecra 550CDT and Compaq's LTE 5300.

The 7.5-pound Nimantics Quanta 6x 133 is an affordably priced ($3999) multimedia notebook with high-end functionality. It has a 12.1-inch SVGA display, a voluminous 2.1-GB hard drive, and an efficient lithium-ion battery that lasts 2 hours and 37 minutes in our tests.

HP's OmniBook 5500 CTS ($6120) costs much more than the Quanta 6x 133, but it's a premium notebook for making presentations with its wide-angle 12.1-inch SVGA display.

Best Low Cost

It's quite a stretch to call any multimedia notebook a low-cost product, but some are easier on the credit card than others. We drew a low-budget line in the sand at $4000, which left us with nine notebooks. The WinBook FX is our low-cost winner. It had high all-around scores and did particularly well in usability. Nimantics' Quanta 6x 133 took the number-two spot, followed closely by Texas Instruments' 100-MHz Extensa 570 CDT.

Dell's Latitude LM P-133ST had the best battery life of all the test units. Its lithium-ion battery and effective power management scheme kept it going for 3 hours and 41 minutes in our battery rundown test. We must also give battery-life honorable mentions to the Gateway Solo S5-133 (3:31) and IBM's ThinkPad 760ED (3:24), which both also use lithium-ion batteries (but aren't low-cost portables).

The 6.1-pound TravelPro 1900 ($3695), from AMS Tech, is a top-quality multimedia portable with a 133-MHz Pentium, a 12.1-inch SVGA display, a 1.3-GB hard drive, and a three-year warranty—components and support you would expect from a higher-priced notebook.

TECH FOCUS: HEAT CONTROL

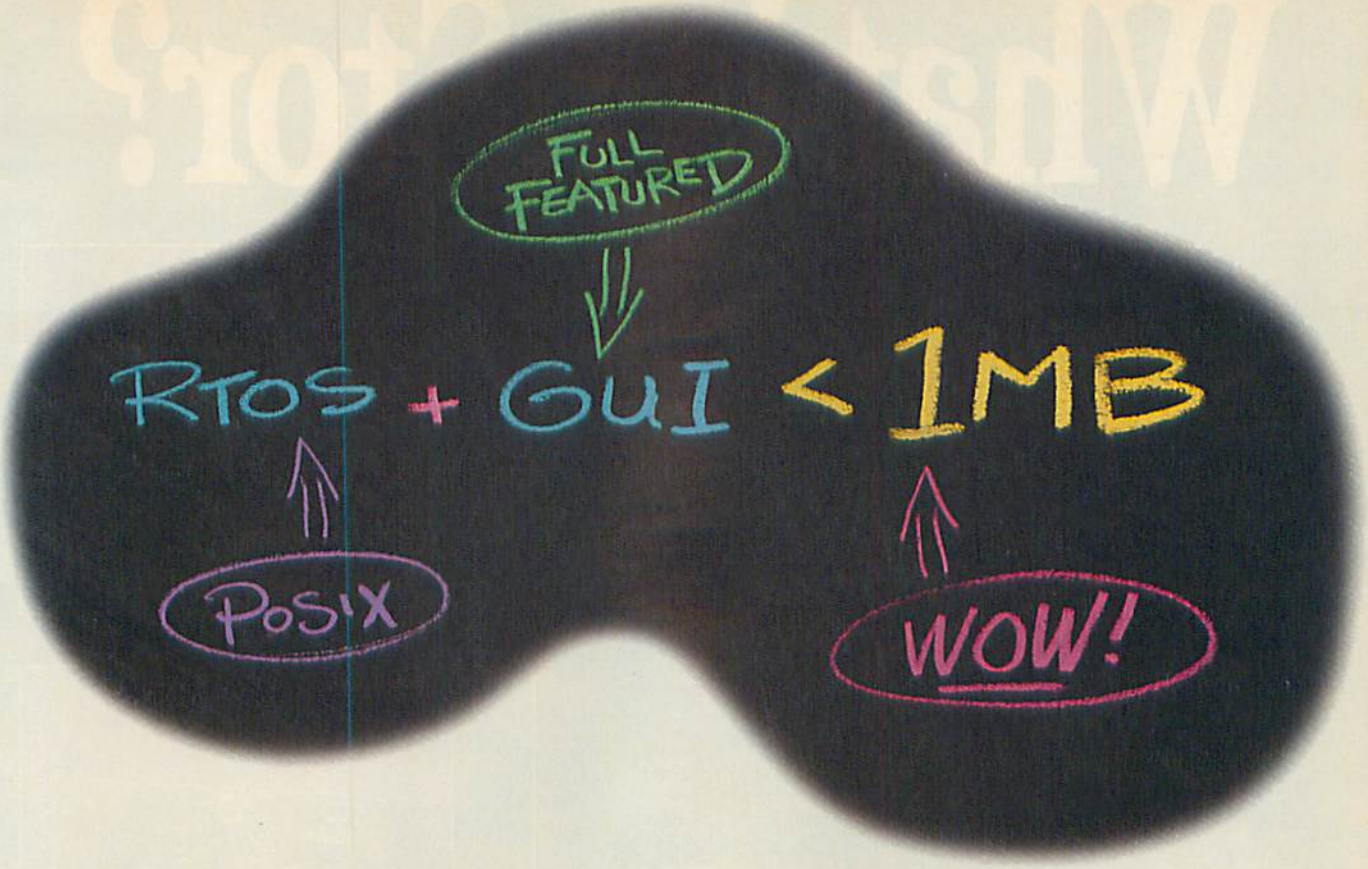
Taking the Heat

Heat is the limiting factor in getting high-end desktop performance out of a portable computer. The more heat a notebook design can dissipate, the faster you can reliably run the CPU or the more memory you can hold. Fan-induced convection cools most desktop systems, but fans are unacceptable in notebooks—they're noisy, power-consuming, and a potential failure point. Convection also needs space for air to move, something compact notebook designs lack.

Good notebook designs rely instead on passive conduction. Heat is conducted away from the CPU, hard drive, and the graphics subsystem to exterior surfaces capable of radiating heat. The keyboard, the I/O port area, and (if it's not a docking unit) the bottom surface of the notebook (that isn't blocked by the battery) are all good surfaces for dissipating heat.

An aluminum heat sink will quickly draw heat away from the CPU, but the heat must then be conducted to the outside. Typically, metal sheets or frame elements, often made of a lightweight, conductive magnesium alloy, serve this purpose. Compaq's Armada 4100 series, for example, has a magnesium chassis that provides structural stiffness to the notebook, a path for outward heat conduction, and external radiation surfaces. Tadpole's notebooks can handle the latest desktop processors because they have a magnesium-alloy case that is thermally connected to the CPU.

Some designs use heat pipes to beef up thermal conduction by metal plates. These small-diameter sealed metal tubes contain a liquid that wicks from one end of the tube to the other, driven by a thermally induced fluid-to-vapor cycle. The pipe serves as a passive but effective heat pump.



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	Reliability				Manageability				
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CR2	•	18GB	0,1,3,5	•	•			
CR6e	•	24GB	0,1,3,5	•	•	•	•	•
CR8	•	72GB	0,1,3,5	•	•	•	•	•

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LAB RESULTS

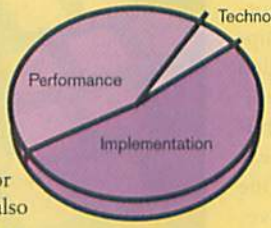
PENTIUM PORTABLES RATINGS

BEST OVERALL

NEC Technologies Versa 6030H

The Versa 6030H ($5799) is our best-overall portable Pentium because it is fast, feature-packed, and easy to use. The 9.5-pound unit races through our benchmarks with a 133-MHz Pentium processor, 256 KB of synchronous pipeline cache memory, a PCI bus, and 2 MB of video memory. The Versa 6030H is a strong multimedia machine with hardware-accelerated MPEG for full-motion, full-screen video playback; a six-speed CD-ROM drive for fast data transfers; and excellent 16-bit stereo sound. The system also has a healthy bundle of applications and telephony features for those who need to keep in touch with the office.

WEIGHTING



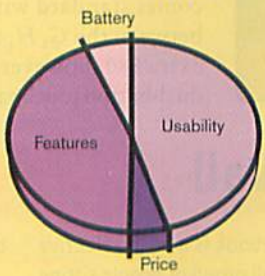
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	BATTERY	OVERALL RATING
NEC Versa 6030H	**$5799**	★★★★	★★★★	★★★★★	★★★★	★★★★★	★★★	★★★★
WinBook FX	$3999	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★	★★★★
Toshiba Tecra 500CDT	$4999	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
Impulse Duonote	$4699	★★★★	★★★★	★★★★	★★★★	★★★★	★★★	★★★★
Compaq LTE 5300	$6398	★★★★	★★★★	★★★★	★★★★	★★★★	★★	★★★★

BEST DESKTOP REPLACEMENT

NEC Technologies Versa 6030H

With its strong performance score, the Versa 6030H is also our choice for best desktop replacement. It is not only efficient but flexible with its easily accessible Versabay II, which supports a floppy drive, an extra hard drive, an extra battery, or the CD-ROM drive. For an extra $799, NEC offers even more desktop functionality with its Docking Station 6000, which has three expansion-card slots, three drive bays, built-in speakers, four audio ports, and an RJ-11 phone jack.

WEIGHTING



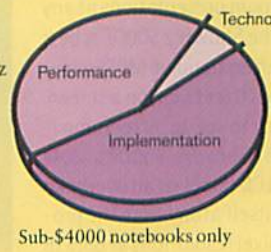
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	BATTERY	OVERALL RATING
NEC Versa 6030H	**$5799**	★★★★	★★★★	★★★★★	★★★★	★★★★★	★★★	★★★★
Toshiba Tecra 500CDT	$4999	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
Compaq LTE 5300	$6398	★★★★	★★★★	★★★★	★★★★	★★★★	★★	★★★★
Nimantics Quanta 6x 133	$3999	★★★★	★★★	★★★★	★★★★	★★★	★★★	★★★★
HP OmniBook 5500 CTS	$6120	★★★★	★★★★	★★★	★★★★★	★★★★	★★	★★★★

LOW COST

WinBook FX

You don't have to pay $6000 for a multimedia notebook. The WinBook FX goes for $3999 and sacrifices little. With a 133-MHz Pentium, 16 MB of RAM, and 1 MB of video memory, the WinBook FX does admirably in our performance benchmarks. The 6.8-pound laptop has an 11.3-inch SVGA display, Sound Blaster Pro–compatible sound, a 1.3-GB hard drive, and a lithium-ion battery that lasts 2 hours and 38 minutes in our Thumper II run-down test.

WEIGHTING



Sub-$4000 notebooks only

	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	BATTERY	OVERALL RATING
WinBook FX	**$3999**	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★	★★★★
Nimantics Quanta 6x 133	$3999	★★★★	★★★	★★★★	★★★★	★★★	★★★	★★★
TI Extensa 570 CDT	$2999	★★★★	★★★★	★★★	★★★★	★★★★	★★	★★★
Dell Latitude LM P-133ST	$2999	★★★★	★★★★	★★	★★★★	★★★★	★★★★★	★★★
AMS Tech TravelPro 1900	$3695	★★★★	★★★★	★★★	★★★★	★★★★	★★★	★★★

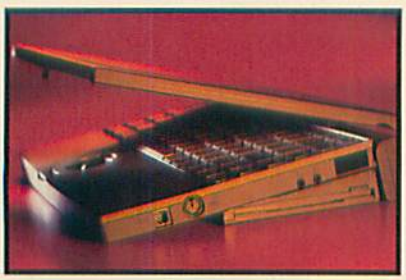
★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

PHOTOGRAPHS: LIGHTWORKS PHOTOGRAPHIC © 1996

Details

Ultracool Design

If you find most notebook designs boringly similar, check out Digital Equipment's HiNote Ultra II. Its sleek, angled chassis should turn the head of any individualist. The HiNote Ultra II has a lithium-ion battery that clips onto the rear and two attachable base modules: One is a thin wedge with a floppy drive, while the larger multimedia base provides speakers and a CD-ROM drive. Do you think Compaq found inspiration here for its new Armada 4100?



Making Your Point

Users can often choose from many different peripherals when buying a notebook, but the pointing device usually isn't one of them. The WinBook FX comes standard with a pointing stick between the *G*, *H*, and *B* keys. For an extra $80, however, you can opt for a dual-button touchpad.

NEC's Bug Barrier

NEC's Versa 6030H has two hot-loaded McAfee antivirus software packages—VirusScan and WebScan—that guard the system from known viruses and provide virus protection for the most popular Internet services, Web browsers, and e-mail.

Up Against the Wall

Hooking a 17-inch monitor to a notebook is a cost-effective way to make a presentation to a small group of people sitting around a table. For larger groups, however, you need projection. You can buy an LCD panel that sits on an overhead projector or a self-contained projection unit. In either case, your notebook drives the display. Wedge Technology's ShowBiz 5000P ($4799) provides another option.

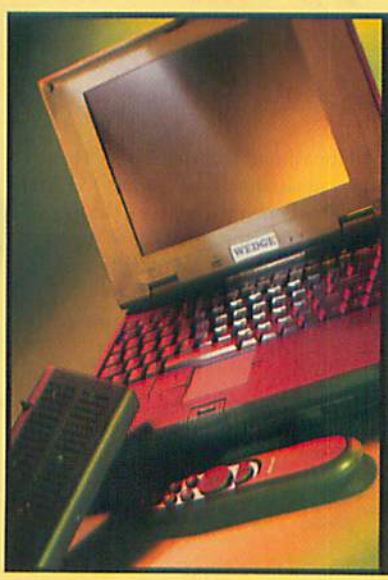
The ShowBiz 5000P is a Pentium notebook with an LCD that converts into an overhead projection panel. Like a few projection notebooks before it (see "Presentation Quality," September 1995 BYTE), the ShowBiz 5000P lets you make large-room presentations at any office with an overhead projector. While the ShowBiz 5000P is best for software demonstrations, Wedge also offers optional MPEG playback and TV cards, so you can project videos 6 feet high on a screen.

We found the LCD projection panel easy to set up. After removing a protective back panel from behind the ShowBiz 5000P's 10.4-inch active-matrix display, you place the LCD panel on an overhead projector. A support tray for the notebook itself attaches to the projector. The display supports 800- by 600-pixel resolutions at 65,536 colors. The unit comes with a cooling fan that connects to the LCD panel to dissipate the heat from the projector's lamp.

Though the projected images are not as bright as on some desktop projectors (see "Road-Show Romance" on page 55), we found the images to be clear and well defined when shown in a fairly dark room. It takes some adjustment of the LCD projection panel to eliminate ambient light from the overhead projector, but that should not be a problem after you get used to setting it up.

The notebook sits directly in the path of the overhead projector, so Wedge supplies an infrared-attached remote-control device so the presenter can control the PC. Mind Path's Presentation F/X software lets you move the mouse around the display and zoom in on different areas of the screen.

—John McDonough



ShowBiz 5000P
$4799 (fully loaded system)

Wedge Technology, Inc.
Milpitas, CA

(408) 263-9888

http://www.wedgetech.com

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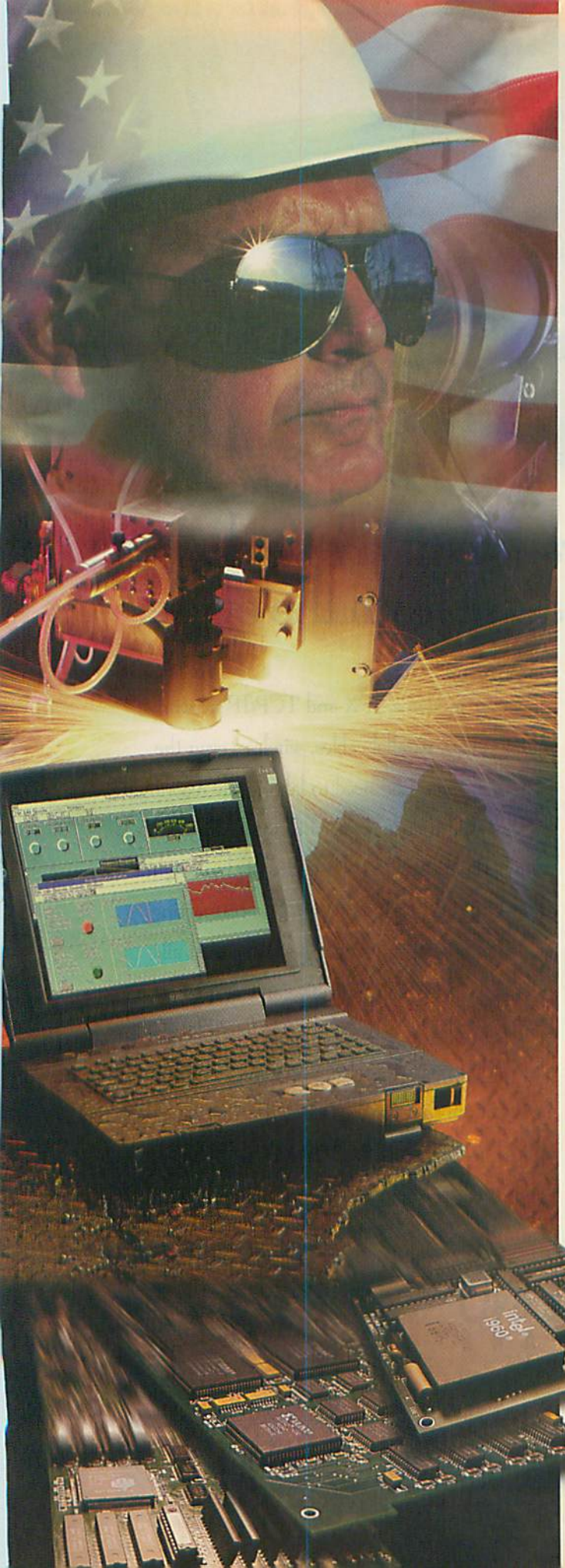

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Test Specs

We picked the best portable Pentiums by running low-level and application benchmarks under Windows 95, as well as battery tests under real-world conditions. We also weighted important notebook features and how easy a system is to set up and use.

Performance

For the Windows 95 application benchmarks, we ran scripts with 32-bit versions of Microsoft Word (7.0) and Excel (7.0) plus a 16-bit version of FoxPro (2.6). NSTL's low-level InterMark Multimedia PC tests exercise specific components of the notebook: CPU, hard drive, CD-ROM drive, and sound (percentage of CPU utilization). InterMark video benchmarks test how well a system can produce multiple Windows draws, bit-mapped images, and display screens generated by applications like PowerPoint and CorelDraw.

Battery Life

We measured battery life with our Thumper II battery run-down tester. Thumper II emulates a typical word processing session. It uses robotic arms and an optical screen sensor to detect and control each system's power management function. Before testing, we completely drained and recharged each notebook's battery twice, according to the vendors' instructions. People use their notebooks in different ways, so you will probably get different battery life with a given portable.

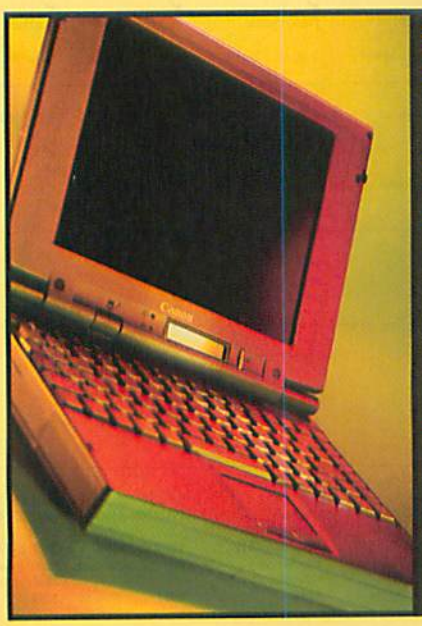
Features/Usability

We reward features that differentiate the notebooks. For instance, AMS, Compaq, Dell, Digital Equipment, Hewlett-Packard, IBM, Impulse, NEC, and Toshiba back their systems with impressive three-year warranties, as opposed to one-year warranties with the other vendors. We asked the vendors to fill out a lengthy features questionnaire, and we verified the features in the labs. For usability, technicians worked extensively with each notebook to assess the quality of the keyboard, status indicators, and pointing device. We also evaluated the user's manuals and checked how easy it was to install modular components and upgrade the systems with memory.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of its monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE Magazine and NSTL are both operating units of the McGraw-Hill Companies, Inc.*

AMD Inside

Not every road warrior can afford to fork over $3000 or more for a Pentium-powered multimedia notebook. Fortunately, Canon Computer Systems' Innova Book 360CD provides Pentium performance without the Pentium price. It's a full-fledged multimedia notebook with a price of only $2599, but it uses the Pentium-compatible 133-MHz 5x86 processor from AMD.



Innova Book 360CD
$2599

Canon Computer Systems, Inc.
Costa Mesa, CA

(800) 848-4123

http://www.ccsi.canon.com

Circle 1064 on Inquiry Card.

The Innova Book 360CD doesn't compare favorably with Pentium systems when tested with NSTL's InterMark test of low-level functions. In particular, it was dead last in memory performance. However, these factors don't appear to matter with Windows application performance. With our application tests, the Canon portable outshone all other test systems.

What's the price trade-off then, if not performance? For one thing, Canon cut costs on components by using a 10.4-inch dual-scan VGA display instead of an active-matrix screen and a nickel-metal-hydride (NiMH) battery instead of a longer-lasting lithium-ion battery. The battery lasted 2 hours and 18 minutes in our battery run-down tests, while lithium-ion-equipped models averaged 2:48.

The 6.7-pound (with battery) Canon notebook is light for a multimedia notebook, and it has a modular design with a four-speed CD-ROM drive on the right side that you can swap with a floppy drive. The laptop has an IrDA infrared port in the back, and a Type III PC Card slot and an external monitor port on the left side. It has a 32-bit VL-Bus architecture and 1 MB of video memory to boost its graphics performance.

The unit is ready to hit the road right out of the box with applications such as Sidekick for Windows 95 and FaxWorks 3.0. It also has on-line user documents for each of the bundled applications, so you don't have to drag manuals with you on business trips. Canon backs the Innova Book 360CD with a one-year warranty for parts and labor. **–Eds.**

PENTIUM PORTABLES FEATURES

VENDOR/MODEL NAME	Altura Computer Systems Bolt2-133	AMS Tech TravelPro 1900	Austin Computer Systems Austin Edge CD	Canon Computer Systems, Inc. Innova Book 360CD	Chem USA Corp. Chem Book 5580	Compaq Computer Corp. Compaq LTE 5300	Dell Computer Corp. Latitude LM P-133ST	Digital Equipment Corp. Digital HiNote Ultra II CTS 5120
Base price (MSRP)	$2995	$3175	$3160	$2599	$2615	$5999	$2999	$4299
Price as tested (MSRP)	$3595	$3695	$4304	$2599	$3575	$6398	$2999	$4299
Overall value	7.46	7.87	7.4	7.74	7.50	8.06	7.88	7.65
Performance score	8.3	7.6	6.6	8.7	7.9	8.2	6.6	7.6
Features score	7.5	8.7	8.2	6.1	7.4	8.7	8.4	7.7
Usability	6.9	8.1	8.1	7.5	7.5	8.8	8.8	8.1
Battery life (hr:min) as tested	1:7	2:3	2:8	2:3	1:9	2:2	3:7	2:7
PROCESSOR								
CPU manufacturer, model, and speed (MHz)	Intel Pentium 133	Intel Pentium 133	Intel Pentium 133	AMD Am5x86 133	Intel Pentium 166	Intel Pentium 133	Intel LM Pentium 133	Intel 5P54CSLM 120
Voltage	3.3	2.9	3.1	3.3	3.3	3.3	3.3	2.9
SYSTEM RAM								
RAM as tested/max. 32-bit RAM (MB)/speed (ns)	8/32/70	8/64/60	8/40/60	8/32/70	16/64/60	16/80/60	8/40/70	8/40/70
Memory architecture	EDO	EDO	EDO	Fast-paged	EDO	Fast-paged	Fast-paged	Paged and interleaved
Max. secondary cache RAM (KB)/speed (ns)	1000/40	256/15	256/15	256/70	256/15	256/12	256/8	256/8
SYSTEM BIOS								
Manufacturer	Award	Phoenix	Phoenix	Phoenix	AMI	SystemSoft	Phoenix	SystemSoft/Digital
VIDEO								
Video-processor chip manufacturer and model	Chips & Technologies 65548	NeoMagic 2070	Cirrus Logic GD7543	Chips & Technologies 65540	Chips & Technologies 65550	Opti Viper	NeoMagic 2070	Chips & Technologies 65548A
Diagonal screen size (inches)	12.1	12.1	11.3	10.4	12.1	12.1	12.1	10.4
Display technology	Active-matrix	Active-matrix	Active-matrix	Dual-scan	Active-matrix	Active-matrix	Active-matrix	Active-matrix
Max. display resolution (pixels)/total colors	800 × 600/65,536	800 × 600/65,536	800 × 600/65,536	800 × 600/256	800 × 600/16,000	800 × 600/65,536	800 × 600/65,536	800 × 600/65,536
Video memory as tested (MB)/bus width (bits)	1/64	1.5/128	2/32	INP/32	2/32	1/32	1/128	1/32
Video memory type	DRAM	VRAM	DRAM	INP	EDO	EDO	DRAM	EDO VRAM
Local-bus video type	PCI	PCI	PCI	VESA VL-Bus	PCI	PCI	PCI	VESA VL-Bus
Max. ext. noninterlaced resolution/ total colors or grays	1280 × 1024/16	1280 × 1024/256	1024 × 768/256	1024 × 768/256	1024 × 768/256	1024 × 768/256	1024 × 768/256	1024 × 768/256
PORTABILITY								
Height × width × depth (inches) × weight (lbs.)	2 × 11.89.1 × 9.5	1.8 × 11.8 × 8.8 × 6.1	2.6 × 11.3 × 8.98 × 6.8	1.9 × 11.5 × 8.9 × 8.4	2.2 × 11.7 × 9.9 × 8.5	2.07 × 12.2 × 9 × 7.4	1.94 × 8.9 × 11.75 × 6.8	1.2 × 8.5 × 11 × 4.2
Battery technology	NiMH	Lithium-ion	Lithium-ion	NiMH	NiMH	NiMH	Lithium-ion	Lithium-ion
Supports multiple battery packs		✔	✔		✔	✔	✔	✔
Supports hot swapping						✔	✔	✔
MASS STORAGE								
Hard drive manufacturer and/or model	Toshiba MK-1301MAV	Toshiba HDMK-2720F	Toshiba MK-2700PC	Toshiba MK-1924FCV	IBM DPRA-21215	Compaq	IBM	IBM DSOA-21080
Hard drive interface type	PCI	PCI	IDE	EIDE	EIDE	IDE	EIDE	EIDE
Hard drive controller cache (KB)	N/A	256	128	128	64	128-KB buffer on drive	N/A	96
Max. hard drive capacity (MB)/access time (ms)	2170/10	2100/12	2000/12	810/13	2000/12	1350/13	810/13	1080/13
Removable hard drive	✔	✔	✔	✔	✔	✔	✔	✔
I/O PORTS (BUILT IN)								
UART type	16550	16550	16550	16550	16550	16550	16550	16550
Centronics parallel-port type	Enhanced, extended, selectable	Enhanced, extended, selectable	Enhanced, extended, selectable	Enhanced, extended, selectable	Enhanced, extended, selectable	Enhanced	Extended, enhanced, selectable	Enhanced, extended, selectable
IrDA-compliant infrared data-exchange port	✔	✔	✔	✔	✔	✔	✔	✔
Pointing device	Touchpad	Touchpad	Touchpad	Touchpad	Touchpad	Pointing stick	Touchpad	Trackball
PC Card slots connected concurrently	2 Type II/1 Type III	2 Type II/1 Type III	1 Type II/1 Type III	2 Type II/1 Type III	1 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III
SOUND								
Sound chip set	Opti 930	ESS 1688	Creative Labs CT2505 (Vibra 16)	INP	ESS 1688	ESS 1688	ESS 1688	ESS 1688
Built-in microphone	✔	✔	✔		✔	✔	✔	✔
H/W speaker volume control	✔	✔		✔	✔	Optional		✔
MPEG hardware and software	Optional/optional	Included/included	/included	N/A / N/A	N/A / included	Optional/optional	N/A / included	
CD-ROM audio out	✔	✔	✔	✔		✔	✔	✔
POWER SUPPLY								
Supports 220/240 AC voltage	✔	✔	✔	✔	✔	✔	✔	
Auto-switching/auto-detecting		✔	✔	✔	✔	✔	✔	✔
Internal AC adapter/battery charger		✔				✔	✔	✔
EXPANSION								
Expansion chassis/price, if optional								
Docking station/price, if optional	✔/$395	✔/$250	✔/$350 or $800			✔/$499		
Number of ISA/PCI expansion slots	0/0	0/1	0/0	0/0	0/0	0/0	0/0	0/0
Number of full-height 3½-inch/ half-height 5¼-inch drive bays	0/0	1/0	0/0	0/0	1/1	0/0	0/0	0/0
WARRANTY								
Length (years)/coverage	1/P,L,R	3/P,L,R	1/P,L,F,R	1/P,L,F,R	1/P,L,R	3/P,L,F,R	3/P,L,R	3/P,L,F,R
Phone	(719) 685-5502	(818) 814-0782	(512) 339-3500	Call local Canon dealer	(510) 785-8080	Call local Compaq dealer	(512) 338-4400	(303) 872-8933
Toll-free phone	N/A	(800) 886-2671	(800) 752-1577	(800) 848-4123	(800) 866-2436	(800) 345-1518	(800) 613-3355	(800) 344-4825
On-line address	N/A	http://www .amstech.com	http://www .austindirect.com	http://www .ccsi.canon.com	chemusa@ix .netcom.com	http://www. compaq.com	http://www.dell.com	http://www.pc .digital.com
Inquiry number	**1061**	**1062**	**1063**	**1064**	**1065**	**1066**	**1067**	**1068**

BYTE Best = BYTE Best ✔ = yes; N/A = not applicable. INP = information not provided by vendor

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

Gateway 2000 Solo S5-133	Hewlett-Packard Co. HP OmniBook 5500 CTS	IBM Corp. ThinkPad 760ED	Impulse Computer Corp. Impulse Duonote	Micro-International, Inc. Mint 5200	NEC Technologies Inc. NEC Versa 6030H	Nimantics Inc. Quanta 6x133	Sceptre Technologies, Inc. Soundx Series 4000	Texas Instruments, Inc. Extensa 570 CDT	Toshiba America Information Systems, Inc. Tecra 500CDT	WinBook Corp. WinBook FX
$5599	$6120	$6999	$4599	$2000	$5799	$2999	$4995	$2999	$4999	$3999
$5599	$6120	$6999	$4699	$3600	$5799	$3999	$5679	$2999	$4999	$3999
7.61	7.93	7.60	8.26	7.16	8.52	7.94	7.46	7.93	8.30	8.42
7.3	7.7	7.0	8.5	7.7	8.9	8.6	7.2	7.6	8.2	8.4
8.0	8.9	8.8	8.4	7.9	8.6	8.4	8.0	7.9	8.2	8.3
8.1	8.8	8.1	8.8	6.9	9.4	6.9	8.1	8.8	9.4	9.4
3:4	2:4	3:2	2:7	0:7	2:5	2:6	2:5	2:2	3:0	2:6
Intel Pentium 133	Intel Pentium 133	Intel Pentium 133	Intel Mobile Pentium 133	Intel Pentium 166	Intel Pentium 133	Intel Pentium 133	Intel Pentium 133	Intel P54C 100	Intel P54CLSM 120	Intel Pentium 133
2.9	2.9	3	2.9	3.3	2.9	3.3	2.9	2.9	2.9	3.1
40/40/60 or 70	16/64/70	16/80/70	16/48/60	8/32/60	16/40/70	16/40/60	16/40/70	8/40/70	16/144/60	16/40/70
Synchronous DRAM	Fast-paged	EDO DRAM	EDO	EDO	Fast-paged	DRAM	EDO	Fast-paged	Paged	EDO
256/9	256/15	256/8	32/8	256/60	256/8	256/60	256/60	256/15	256/8	256/8
Intel	SystemSoft	IBM	SystemSoft	SystemSoft	Phoenix/NEC	SystemSoft	Phoenix	Phoenix	Toshiba	Phoenix
Chips & Technologies 65548	Chips & Technologies 65548	Trident Cyber 9385	Chips & Technologies 65548	Cirrus Logic GD7543	Chips & Technologies 65550	Chips & Technologies 65548	NeoMagic 2070 and 2096	Cirrus Logic GD7543	Chips & Technologies 65550	Cirrus Logic GD7543
11.3	12.1	12.1	11.3	12.1	12.1	12.1	12.1	10.4	12.1	11.3
Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix	Active-matrix
800 × 600/256	800 × 600/65,536	800 × 600/256	800 × 600/65,536	800 × 600/65,536	800 × 600/65,536	800 × 600/65,536	800 × 600/256	800 × 600/16,000	800 × 600/16,000	800 × 600/65,536
1/16	1/32	2/64	1/21	2/32	2/64	1/32	1/64	1/32	2/32	1/32
Synchronous DRAM	EDO	VRAM	VRAM	DRAM	Burst-mode EDO	VRAM	EDO DRAM	DRAM	EDO DRAM–burst mode	DRAM
VL-Bus	PCI	PCI	PCI	PCI	PCI	PCI	PCI	PCI	PCI	PCI
1024 × 768/256	1024 × 768/256	1280 × 1024/256	1024 × 768/256	1024 × 768/256	1024 × 768/65,536	1024 × 768/65,536	1024 × 768/256	1024 × 768/256	1280 × 1024/256	1024 × 768/256
2 × 11.8 × 8.8 × 6.7	11.6 × 8.9 × 1.93 × 7	11.7 × 8.3 × 2.14 × 7.38	1.5 × 8.5 × 11 × 6.5	2.1 × 11.8 × 8.9 × 9	2.1 × 11.7 × 9.5 × 9.5	2 × 11.9 × 7.6 × 7.5	1.94 × 11.7 × 8.9 × 6.8	2.2 × 9 × 11.6 × 8.9	2.28 × 11.77 × 9.25 × 8.2	2.15 × 11.3 × 8.98 × 6.8
Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion	NiMH	Lithium-ion	Lithium-ion	Lithium-ion	NiMH	Lithium-ion	Lithium-ion
	✔	✔		✔	✔	✔	✔	✔		✔
✔	✔	✔	✔ (suspend mode)	✔	Warm-swappable	✔	✔	✔		
IBM	IBM DPRA-21215	IBM	Fujitsu MK-2714T	Toshiba MK-2101MAN	IBM	Toshiba MK-2720FC	IBM DSOA-21080	Hitachi DK-212A-81	Toshiba MK-1301MAV	Toshiba MK-2720FC
EIDE	IDE	IDE	IDE	EIDE	EIDE	IDE	PCI EIDE	IDE	EIDE	PCI EIDE
64	INP	256	128	32	Included in Intel's Mobile Triton chip set	128	45	INP	16	128
2000/12	2000/13	1200/12	1088/12	2100/13	1440/13	2100/30	1080/13	1200/16	2500/13	1300/13
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
16550	16550	16550	16550	16550	16550	16550	16550	16550	16550	16550
Enhanced	Enhanced	Enhanced	Enhanced, extended, selectable	Enhanced, extended, selectable	Enhanced	Enhanced, extended, selectable	Enhanced	Selectable	INP	Enhanced, extended, selectable
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Touchpad	Trackball	Pointing stick	Touchpad	Touchpad	Touchpad	Touchpad	Touchpad	Touchpad	Pointing stick	Pointing stick or touchpad
2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/2 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III	2 Type II/1 Type III
ESS 1688	Crystal CS 33242	INP	ESS 1688	ESS 1688	Sound Blaster 16	ESS 1688	ESS 1688	ESS 1688	Crystal	Creative Labs
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
✔		✔	✔	✔	✔	✔	✔	✔	✔	
	N/A / N/A	Included/included	/optional	Optional/optional	Included/included	Optional/optional	Optional/optional	N/A / N/A	Included/included	/✔
✔	✔	✔	✔		✔	✔	✔		✔	✔
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
✔									✔	
✔/$150				✔/$200	✔/$199			✔/$138	NoteDock Enhanced Port Replicator/$599	
	✔/$699	✔/$499	✔/included		✔/$899	✔/$249	✔/$699		✔/$949	
0/0	0/0	0/0	0/0	0/0	0/2	0/0	0/2	1/2	INP/3	0/0
0/0	0/0	0/0	0/0	1/0	1/2	0/0	1/1	1/0	0/1	0/0
1/P,L,R	3/P,L,R	3/P,L,F,R	3/P,L,F,R	1/P,L,R	3/P,L,F,R	1/P,L,R	1/P,L,R	1/P,L,F,R	3/P,L	1/P,L,R
(605) 232-2000	Call local Hewlett-Packard dealer	(914) 766-1900	(905) 858-3000	(713) 495-9096	(508) 264-8000	(714) 573-4030	(818) 369-3698	Call local Texas Instruments dealer	(714) 583-3000	N/A
(800) 846-2000	(800) 443-1254	(800) 772-2227	(800) 668-1111	(800) 967-5667	(800) 388-8868	(800) 886-2671	(800) 788-2878	(800) 848-3927	(800) 457-7777	(800) 468-2162
http://www.gw2k.com	http://www.hp.com	http://www.pc.ibm.com	http://www.impulse.ca	http://www.pcmint.com	http://www.nec.com	http://www.nimantics.com	http://www.sceptretech.com	http://www.ti.com	http://computers.toshiba.com	N/A
1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079

Running on NT

Is Microsoft's Windows NT 4.0 the answer to our OS prayers or just a set of incremental improvements?
By Robert L. Hummel

Without any fanfare, Microsoft has released the long-awaited upgrade to its high-end workstation and server OS products: Windows NT 4.0 Workstation and Server. In contrast to the pop-rock launch for the consumer-oriented Windows 95, Microsoft is aiming NT 4.0 squarely at business users. And with an impressive list of features and performance improvements, NT appears to hit its target.

NT 4.0 seems to promise something for everyone. For Windows 3.x users who want more reason to upgrade than just the pretty face of Win 95, NT 4.0 adds an alluring combination of stability and security. Users get a performance boost, a wide range of new and better features, and enhanced Internet connectivity.

The sweeping changes made to NT 4.0 touch nearly every service and aspect of the OS. It's easy to see signs of upgrades in the interface, management tools, Internet and networking capabilities, programming interfaces, and performance.

Performance

We've had beta versions of the new NT in the BYTE lab for a while. However, it wasn't until Microsoft handed us the final release code—barely in time to make this issue—and we did some real-world testing with the actual OS that we could determine how well NT's performance matches its promotion.

The features table and performance charts on pages 128 and 129 summarize our findings. Except where noted, performance results are for NT 4.0 Workstation. We focused more heavily on Workstation because, to users of Windows 3.x, the target audience for the upgrade, it's unfamiliar. In contrast, those users interested in NT Server are likely already familiar with NT's capabilities from their experience with version 3.51.

We configured three mainstream systems for testing: a Gateway Pentium-133 with 64 MB of RAM, a Gateway Pentium Pro-150 with 64 MB, and a Cyrix 6x86-P200 with 32 MB. The hard disks in the Gateway systems were connected to the system boards' IDE interface. The Cyrix system used an Adaptec AHA-2940 SCSI adapter and a SCSI hard drive.

Each system was equipped with a PCI-based Matrox Millennium video adapter configured for 1024- by 768-pixel resolution with 256 colors. Matrox supplied video drivers for Win 95 and NT 3.51, and we used the Microsoft video driver that comes with NT 4.0.

BYTE'S TAKE
WINDOWS NT 4.0

A new (Windows 95) interface, Internet support, and distributed object technology make NT 4.0 worth buying, despite the installation hassles caused by its numerous hardware and software incompatibilities.

To evaluate performance, we used the new SYSmark/32 1.0 benchmark for Win 95 and NT platforms. This test measures performance in six categories by executing scripts that run eight real-world applications: Adobe PageMaker 6.0, CorelDraw 6.0, Lotus Freelance 96, Lotus WordPro 96, Microsoft Excel 7.0, PowerPoint 7.0, Word 7.0, and Paradox 7.0.

The results of this first round of tests (see the benchmark charts on page 128) show a clear trend: NT Workstation 4.0 outperforms both NT 3.51 and Win 95. On the Cyrix system, however, we discovered that a change made to the NT code just before final release produced some surprising results (see the text box "NT 4.0 Bogs Down on Cyrix 6x86" on page 128 for more information).

On the Pentium system, NT 4.0 bested Win 95 in all categories, delivering an average 12 percent performance increase. NT 4.0 showed a stunning improvement of 49 percent in the graphics test and 33 percent in desktop publishing. Microsoft's decision to move the display and print drivers into the kernel (see the Tech Focus on page 130) and its attention to optimization have clearly paid off.

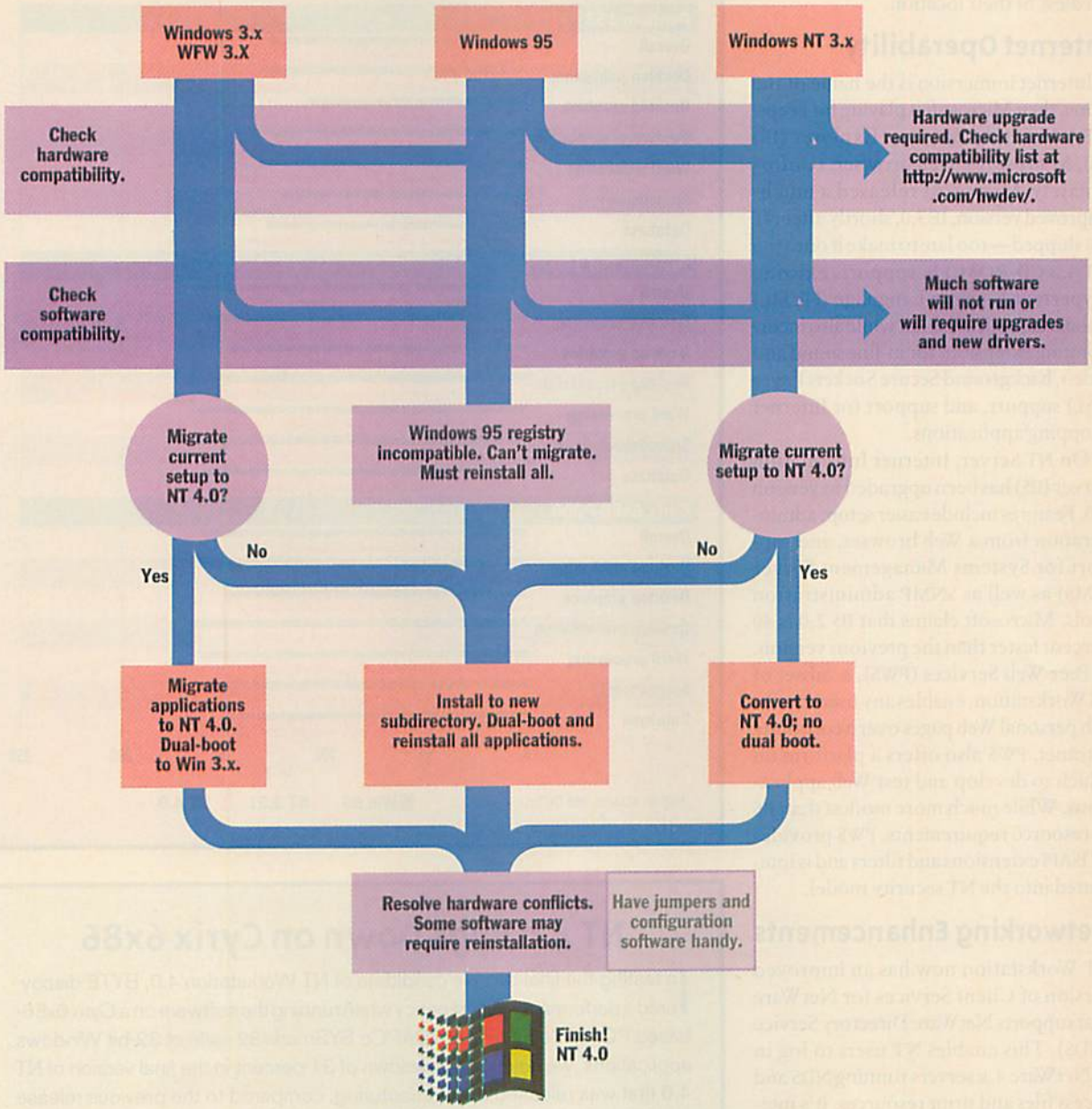
The improvement over NT 3.51 averaged 30 percent. We attribute this seemingly high score to a 45 percent increase in word processing scores and a 40 percent increase in spreadsheet scores, results that are due to the poor performance of 3.51, which fell below that of Win 95 in those categories.

The performance differential between NT 4.0 and Win 95 is much more dramatic on the Pentium Pro system. The Pentium Pro's CPU core is optimized for 32-bit operation at the expense of 16-bit instructions, so it naturally favors NT over Win 95, which is still built around 16-bit DOS code. Improvements in the graphics architecture also contributed to the 68 percent increase in the graphics benchmark.

Again, NT 3.51's lackluster word processing and spreadsheet performance are obvious, allowing Win 95 to turn in better scores, even on the Pentium Pro. In the same tests, NT 4.0 shows increases of 40 percent and 29 percent, respectively. Increases in the other graphics-based tests range from 12 percent to 22 percent.

Windows NT Server 4.0 is also faster than NT 3.51 Server. We compared old

Upgrade: The Roads to 4.0



Upgrading to NT 4.0 from other versions of Windows can be a low-cost, easy job or an expensive nightmare requiring you to replace much of your hardware and software.

and new Server versions of NT using a SQL server benchmark developed by NSTL (see "Powerhouse Pentium Pro Servers," September BYTE, for test details). Running Microsoft SQL Server 6.5 under both versions of NT Server on a four-processor, 200-MHz ALR Revolution Quad6, we noted a 5 percent overall performance increase under NT 4.0 Server when testing with up to 16 users. The test is CPU- and memory-intensive and doesn't measure I/O performance.

Interface and Management

Surely the most prominent change to NT 4.0 is the addition of the Win 95 user interface. Present are the familiar Start button, Taskbar, Shortcuts, Network Neighborhood, and My Computer. Also included is Windows NT Explorer, which provides a hierarchical view of each drive and folder, including network drives.

Desktop management should get easier for system administrators as well. NT's User Profiles and System Policies provide a convenient means to control access to network and desktop resources. System policies help administrators to standardize desktop configurations and enforce behavior. And you can store roaming us-

ers' profiles on an NT server so that users always receive the same desktop, regardless of their location.

Internet Operability

If Internet immersion is the name of the game, then Microsoft is playing for keeps. NT 4.0 includes Internet Explorer (IE) 2.0, Microsoft's Web browser. (Unfortunately, Microsoft released a much-improved version, IE 3.0, shortly after NT 4.0 shipped—too late to make it onto the NT 4.0 CD-ROM.) IE supports existing Hypertext Markup Language (HTML) standards, such as tables, while also incorporating extensions for in-line sound and video, background Secure Sockets Layer (SSL) support, and support for Internet shopping applications.

On NT Server, Internet Information Server (IIS) has been upgraded to version 2.0. Features include easier setup, administration from a Web browser, and support for Systems Management Server (SMS) as well as SNMP administration tools. Microsoft claims that IIS 2.0 is 40 percent faster than the previous version.

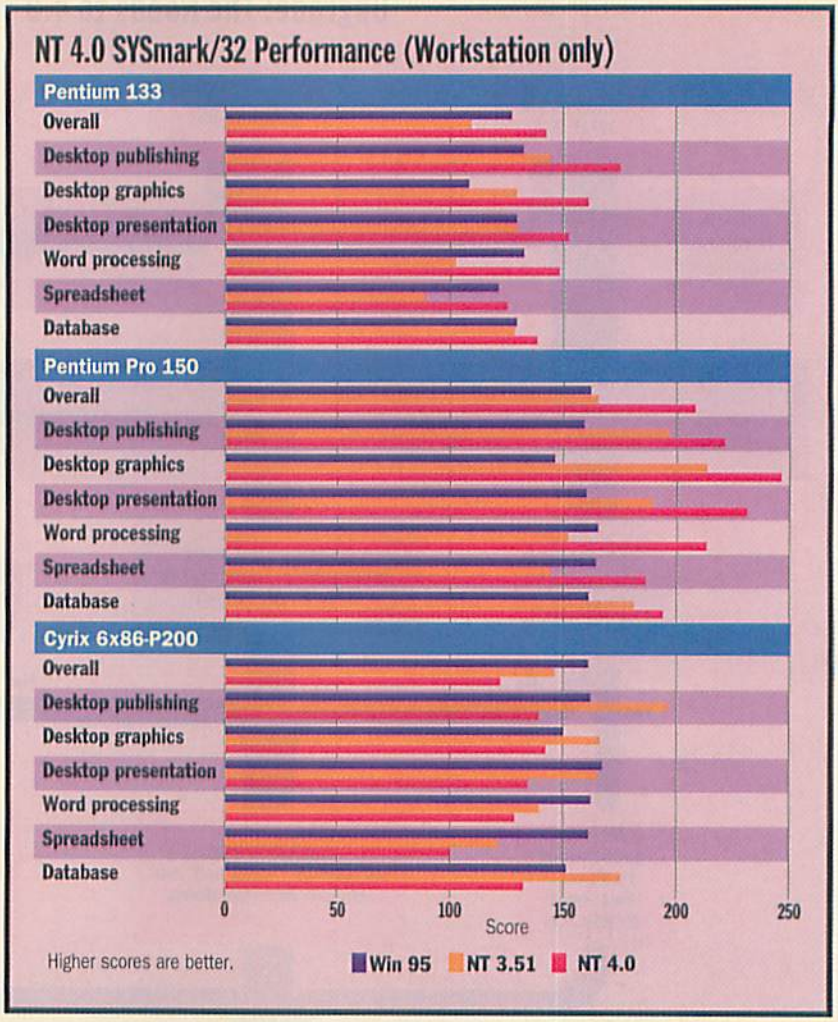
Peer Web Services (PWS), a subset of IIS Workstation, enables any user to publish personal Web pages over a corporate intranet. PWS also offers a platform on which to develop and test Web applications. While much more modest than IIS in resource requirements, PWS provides all ISAPI extensions and filters and is integrated into the NT security model.

Networking Enhancements

NT Workstation now has an improved version of Client Services for NetWare that supports NetWare Directory Service (NDS). This enables NT users to log in to NetWare 4.x servers running NDS and access files and print resources. It's integrated into NT and offers NDS authentication, browsing and print capability, and full support for NetWare log-in scripts, property pages, and NDS passwords.

The Point-to-Point Tunneling Protocol (PPTP) is an open standard that allows you to use the Internet, or other public carriers, to provide secure connectivity between remote clients and public networks. It also provides the basis for Microsoft's Virtual Private Network (VPN) technology.

Using PPTP, remote users can dial into a local Internet provider and tunnel into their corporate network, seeing the same security and features found on their pri-



NT 4.0 Bogs Down on Cyrix 6x86

In testing the final-release candidate of NT Workstation 4.0, BYTE discovered a performance discrepancy when running the software on a Cyrix 6x86-based PC. While running the BAPCo SYSmark/32 suite of 32-bit Windows applications, we noticed a slowdown of 31 percent in the final version of NT 4.0 that was released to manufacturing, compared to the previous release candidate. In both cases, BYTE tested NT on the same PC, which uses the Cyrix 6x86-P200+ running at 150 MHz (see the charts above).

Intel-based PCs running the same NT beta software did not exhibit such a performance decrease from one NT beta to the next. Additionally, NT 4.0 running on the same Pentium system ran the SYSmark/32 applications suite an average of 30 percent faster than NT 3.51, and 12 percent faster than Windows 95. Pentium Pros ran NT 4.0 26 percent faster than NT 3.51, and 28 percent faster than Win 95. The Cyrix 6x86, on the other hand, ran NT 4.0 16 percent slower than NT 3.51, and 24 percent slower than Win 95.

Microsoft added code to NT to change the way it runs on Cyrix-based PCs. Phil Holden, a product manager in Microsoft's Desktop & Business Systems Division, confirmed these changes were made to make NT more stable on the Cyrix platform. This may be the source of the application's performance slowdown. BYTE will have a full report next month. **–Dave Andrews**

vate network. From the user's perspective, the physical connection path is irrelevant; the VPN tunnel encapsulates all data in IP packets. VPN supports all the major network protocols, including TCP/IP, IPX/SPX, and NetBEUI.

The updated version of Dial-Up Networking now provides *channel aggregation*, the ability to combine the bandwidth of all available dial-up lines to achieve higher transfer speeds. For example, you can combine two PPP-compliant ISDN B channels or two standard modem lines to double the effective bandwidth. You can also mix ISDN lines with standard analog modem lines.

Two NT server services, Windows Internet Name Service (WINS) and Domain Name System (DNS), have been combined to provide a form of dynamic DNS. Users can enter fully qualified DNS domain names, making it easier to connect to system resources.

NT now supports the Windows Messaging Client, a universal e-mail inbox that includes drivers for Internet and Microsoft mail. Internet support includes the ability to exchange mail over any network with SMTP or Post Office Protocol 3 (POP3) services. Messaging Client includes full MAPI 1.0 support, allowing you to send, receive, organize, and store e-mail and file-system objects.

Network OLE, which is now dubbed Distributed Component Object Model (DCOM), is a step closer to reality in this release. DCOM, a system of software objects designed to be reusable and replaceable, in theory allows you to distribute processes across multiple computers by providing the object-based communications infrastructure. NT 4.0 supports DCOM by hiding the details of application pointers from both the application and the object.

New APIs

NT 4.0 now supports several new or updated APIs. For example, a set of encryption APIs lets developers create applications that work securely over nonsecure networks, such as the Internet.

For instance, Telephony API (TAPI) provides a platform for developing end-user computer telephony and communications applications. TAPI abstracts a wide array of telephone hardware and services, providing a standard programming interface. TAPI hides the actual details of a phone connection from an application in the same way that a network relieves an application from knowing the physical location of a printer.

NT 4.0 now supports the multimedia APIs introduced in Win 95. DirectDraw provides a device-independent way to access display-dependent features, such as memory, bit block transfer, and color decompression. It also enables digital video playback by taking advantage of the various types of hardware support available on video adapters, such as video stretching.

DirectInput offers joystick support and control. The DirectPlay API provides simplified access to communications protocols and on-line services for games. The DirectSound API provides direct control of audio hardware and is designed to enable 3-D audio support in games. Under NT 4.0, however, DirectSound is emulated, and calls get translated to existing Win32 API calls at run time.

Support for these multimedia APIs will enable developers to create games and other applications for NT that were previously limited to Win 95. In addition, the Compact Disk File System (CDFS) has been upgraded to support Auto-Run and CD-XA, the format for video CDs that contain MPEG movies.

Shortcomings

The Plug and Play (PnP) philosophy states that your computer, add-in hardware, and software should work together without user intervention to configure themselves and resolve any conflicts. It's a noble goal, but it's one that NT doesn't yet reach in this release.

As partial compensation, NT supports hardware profiles, allowing users to select from a list of known configurations (e.g., docked and undocked configurations for a notebook computer). Profile variables might include video resolution, network cards, and client services.

Other aspects of PnP can cause problems when you're installing NT 4.0. Interrupt-request (IRQ) and I/O-address conflicts between hardware components that Win 95 resolved, for instance, often stopped our NT installation in its tracks. Whether or not you're using PnP periph-

FEATURES

	WIN 95	NT 4.0	NT 3.51
Minimum/recommended RAM	8/16	16/32	12/16
Typical disk space required (MB)	40	120	90
Minimum x86 processor	386	486	386
Runs on PowerPC-, Mips-, and DEC Alpha AXP–based RISC systems	✔	✔	✔
486 emulator for RISC machines	N/A	✔	
Scalable: supports multiprocessor configurations		✔	✔
Automatic upgrade path to NT 4.0		N/A	✔
Windows 95–style GUI	✔	✔	
Windows Explorer file browser	✔	✔	
Plug and Play dynamic configuration	✔	(Can use hardware profiles)	
Dynamic PC Card support	✔		
Power management	✔		
System policies to provide centralized control over desktop configuration	✔	✔	
DCOM support		✔	
NTFS support		✔	✔
File compression	VFAT	NTFS	NTFS
Peer-to-peer networking	✔	✔	✔
Peer Web Services		✔	
Windows Internet Name Service		✔	
Client-side NDS support	✔	✔	
PPTP support		✔	
Multilink PPP connections with channel aggregation		✔	
Multimedia API support (DirectPlay, DirectDraw, DirectSound, DirectInput)	✔	✔	
OpenGL 3-D graphics libraries	✔	✔	✔
Direct3D	✔		
Telephony APIs	✔ (version 1.4)	✔ (version 2.0)	
Cryptography APIs		✔	

✔ = yes; N/A = not applicable.

RATINGS

TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

erals, make sure that you know the I/O-address and IRQ requirements for your hardware and have your jumper settings or configuration software and driver disks handy before you begin installation.

Caching disk controllers can also be a problem under NT because a reboot or a power failure could occur before the cache is flushed. Support for caching is limited to the DPT or IBM SCSI adapters for which drivers exist. However, you can use other controllers in write-through mode or with caching disabled.

It's reasonable to expect that some older, obsolete hardware won't be supported in a new OS release. However, NT 4.0 lacks support for wave-table sound on current Sound Blaster PnP sound cards. Support for the ATAPI CD-ROM interfaces on these cards is also nonexistent. Before you plunge into an upgrade, be sure to check out the latest hardware compatibility list at Microsoft's Web site (http://www.microsoft.com/hwdev).

In general, applications that attempt to access hardware directly won't work. This includes software to control sound cards, video cards, scanners, and so on. In addition, NT doesn't support virtual device drivers (VxDs), so a lot of multimedia applications, games, and memory management utilities won't work. Other applications may fail due to poor programming practices; for instance, they may refuse to install under NT instead of checking whether the required services are available.

Users of Win 95 might be disappointed that there is no automatic upgrade path to NT 4.0. Microsoft attributes this to differences in registry architectures between the two products and assigns partial blame to applications that store files in different places on the two systems. Installing NT 4.0 on a Win 95 system requires that you install to a new directory and then reinstall all your applications. For advice on the issues and procedures involved, check Microsoft's upgrade paper at http://www.microsoft.com/ntworkstation/95tontw.htm. For an overview of the upgrade process, along with the possible paths and pitfalls, see the figure "Upgrade: The Roads to NT 4.0" on page 127.

Windows' perennial lack of driver support continues to plague this release of NT (by comparison, Win 95 supports approximately 1000 more drivers than NT does). Categories in which NT falls short include video, audio, and PC Card subsystems. The Win32 Driver Model (WDM) is being advanced to address this problem by providing a common set of I/O services and binary-compatible device drivers for future versions of NT and 95.

Finally, if you have been running NT on a 386-based system, Microsoft has a message for you: It's time for you to stop. Performance considerations aside, NT 4.0 is now coded to require a 486 or higher processor to run on x86-based systems.

Within the limits of the NT architecture, Microsoft has done a good job of supporting hardware peripherals. NT 4.0 recognizes and configures itself automatically for a greater variety of hardware during installation than version 3.51 does. And Microsoft has provided new NT 4.0–style drivers for a wide range of printers and video systems.

There's no doubt that NT 4.0 has a slick interface, powerful features, and raw performance. The more important question is whether it will work with your hardware and software. You'll have to answer those questions yourself, mainly through trial and error. But all in all, NT 4.0's better performance and greater feature set are adequate compensation for any upgrade troubles. B

Robert L. Hummel is a computer programmer, consultant, and author. You can reach him at **rhummel@monad.net** *or at* **editors@bix.com.**

PRODUCT INFORMATION

Windows NT 4.0
Workstation: $319; upgrade, $149.
Server: five-user license, $809; 10-user license, $1129; upgrade from 3.x, $409 (for first 90 days).
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TECH FOCUS ARCHITECTURE

Getting to the Kernel: Is NT Still Safe?

To improve NT 4.0's performance, Microsoft moved some of the OS's most critical processes closer to the unprotected code of the microprocessor. Now NT's Graphical Device Interface (GDI)—which handles all writing to the screen—is in the NT Executive; this gives it Ring 0 status and potential access to important system-data structures. Ring 0 is one of the Intel processors' four protection modes, in which OSes typically run trusted or performance-sensitive kernel-level processes, such as file management and keyboard input.

This move raised concern that NT would be less stable and more likely to crash. We seriously considered trying to prove or disprove the point by trying to "break" NT 4.0 with older video cards and drivers. But we quickly realized that such tests would take a lot of work to prove what we already know from analysis: NT 4.0's stability will not be substantially affected by the Ring 0 change.

The real issue is—and always has been—unruly or buggy device drivers. Essentially, they have always been part of the OS and have had low-level control of the CPU. Bad ones will crash NT 4.0, just as they've brought all its predecessors to their knees. Microsoft is trying to steer people away from risky behavior by telling them to use only hardware that's on a Microsoft-approved list. A product's placement on the list means that Microsoft has written and debugged its device driver.

Admittedly, this smacks of a smug solution that serves to place the onus on users while requiring them, in some cases, to buy new hardware when they upgrade to NT 4.0. But again, the same was true with previous versions of NT. We think most corporate buyers of NT are not likely to stumble blindly into hardware conflicts, especially with their mission-critical servers.

It's true that when NT's GDI wasn't in the kernel's memory space, a crash theoretically was more likely to freeze only the screen, leaving background processes intact. We haven't heard of this ever happening, however. Besides, rebooting would be inevitable, since at some point the user would need access to screen output.

Finally, some nervousness about the GDI move to the NT kernel derives from a misunderstanding about what Ring 0 status means. It does not mean that a process has carte blanche to write anywhere in memory that it pleases. Rules exist, but poorly written or malicious drivers have always been able to ignore them. –Eds.

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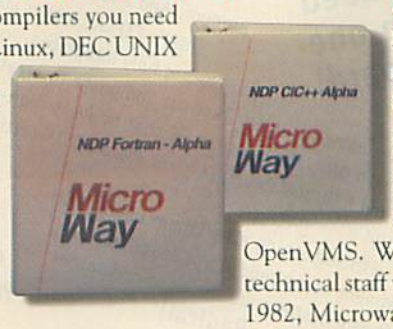

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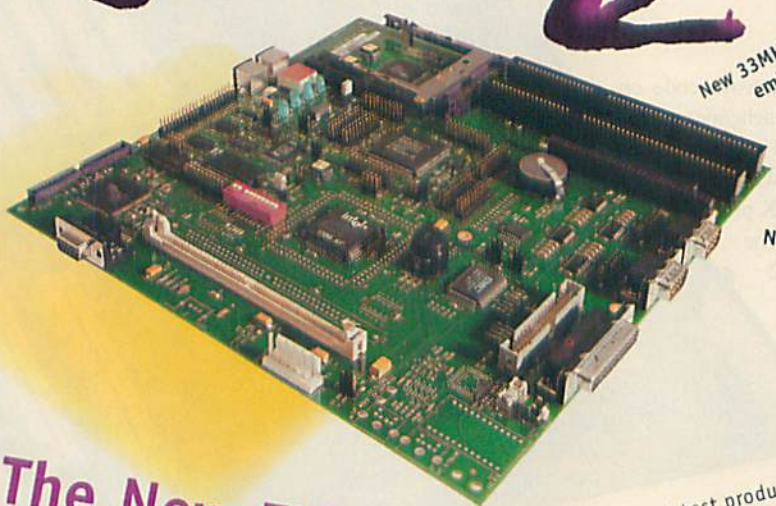

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Jon Udell

Web Project

Web Surveys

Helpful techniques for Web-based data collection and analysis.

The BYTE Site is, among other things, a giant survey application. Each of its 6000+ archive pages presents a link to a feedback form. Or rather, as I explained last October (http://www.byte.com/art/9510/sec9/art1.htm), to a script that generates a form that's customized for each article. Recently, I began harvesting this data to answer questions like "How highly do site visitors rate State of the Art articles?" and "How often do site visitors say they read BYTE magazine?" We've also run Web surveys to ask visitors about their experiences with ISDN, assessment of uninterruptible power supplies (UPSes), and OS preferences.

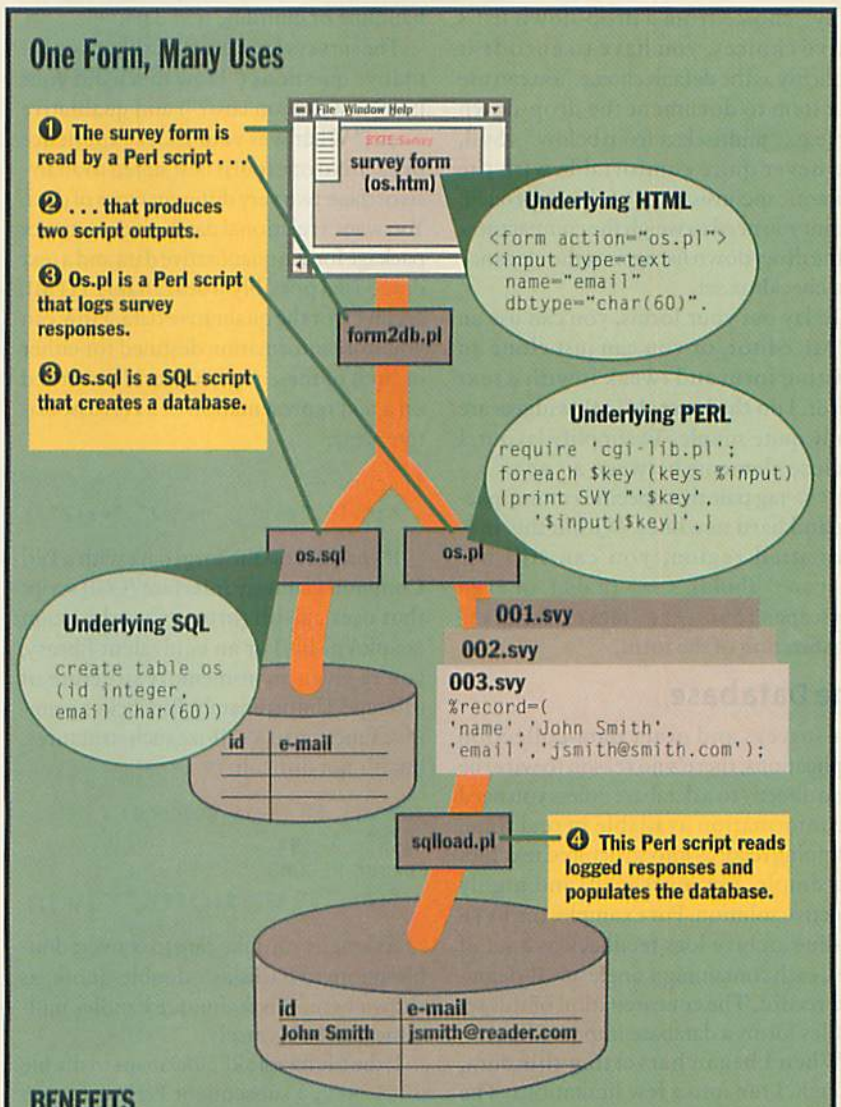
Along the way, I've refined the techniques and tools I use to capture, store, and analyze survey data. I hope you'll find them useful for surveys and other kinds of Web-based data collection and analysis.

The Form

I tend to bail out when confronted by a sprawling multipart Web form, and I assume you do, too. So I try to make my own forms as concise as possible—ideally, just a single screen. The most effective space-saving device is the Hypertext Markup Language (HTML) `<select>` tag. The drop-down lists that it creates ask multiple-choice questions far more compactly than arrays of radio buttons or checkboxes can. Forms built with drop-down lists render more quickly. Browsers tend to struggle when given too many discrete form elements.

While I prefer the drop-down list, two circumstances militate against its use: multiple selection and no sensible default.

http://www.byte.com/
Web Project Conference



PHOTOGRAPH: KELLIE WALSH © 1996

The <select> tag does, of course, support multiple selection. You simply add the attribute multiple="yes." However, a multiselect drop-down list looks the same as a single-select one. No visual cues tell you that multiple selection is available or that Ctrl-click is the way to operate it. Explaining these things chews up screen space. If the number of choices is not too large, you may be better off with a self-explanatory set of checkboxes.

Without a sensible default choice, there's a similar trade-off between a drop-down list and checkboxes. A drop-down list always returns a value; a checkbox set may not. To differentiate a passive "no reply" choice from a drop-down list's active choices, you have to encode it explicitly as the default choice. You can use that item to document the drop-down list (e.g., "multiselect from below"). Still, I'm never quite comfortable with the semantic inconsistency of this approach. Again, you need to weigh the compactness of the drop-down list against the elegance of a checkbox set.

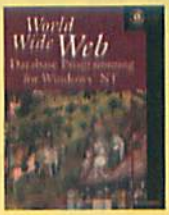
To lay out your forms, you can use an HTML editor, or you can just clone an existing form and tweak it with a text editor. I do the latter; HTML widgets are really quite simple. To simplify layout, I enclose elements between a <pre>... </pre> tag pair that specifies monospacing and hard newlines. Within this preformatted region, you can still use (bold), (italic), or even Netscape <font size> tags to clarify the organization of the form.

The Database

For surveys and other data-collection applications, there's no reason to wire the form directly to a database unless you need the information available in real time. Dumping records into structured text files is a simple, low-overhead, and highly effective solution. For example, the BYTE on-line archive logs feedback as a set of files, each containing a single ASCII-delimited record. The concatenation of this set of files forms a database import file.

When I began harvesting this data, though, I ran into a few limitations. The import records weren't self-descriptive—that is, they didn't carry field names along with values. Lacking names, an import tool must rely on an ordering of fields defined elsewhere. Many import tools allow a special first row of field names. But including such a row in each record wouldn't solve another problem—poor handling of multiline text data.

BOOKNOTE



World Wide Web Database Programming for Windows NT ($39.95)
by Brian Jepson
John Wiley and Sons

http://www.wiley.com/compbooks/
A great Perl-oriented tutorial for NT-based Web developers.

The surveys I run usually ask both quantitative questions ("How much did your ISDN installation cost?") and qualitative ones ("What was your ISDN experience like?"). No one tool is best suited to analysis of these two very different types of data. You want a relational database or statistics package for the quantitative data and a text database (possibly a searchable HTML archive) for the qualitative data. How can you store information destined for either or both of these repositories? I've settled on a text representation of a Perl associative array:

```
%record =
('name1',"val1",'name2',"val2");
```

If you process the form data with a Perl Common Gateway Interface (CGI) script that uses cgi-lib (http://www.bio.cam.ac.uk/cgi-lib/) or an equivalent library, you're given an in-memory structure of this type. Unfortunately, Perl lacks a primitive function to ASCII-ize such structures, but it's not difficult:

```
foreach $f (keys %record) {
 s/\"/\\"/g;
 print RECORD
"'".$f."\',\"".$in{$f}."\",\n";}
```

As long as you take care to convert double-quote to backslash-double-quote, as shown here, this technique handles multiline text fields nicely.

If the file handle RECORD maps to the file 0001.REC, a subsequent Perl script can parse and reconstitute the %record array with the single statement

```
do '0001.REC';
```

What's the point of all this? It's now trivial to write Perl scripts that transform collections of such files into a variety of database import formats or directly to an HTML textbase. For relational analysis, sqlload.pl (http://www.byte.com/art/download/sqlload.pl) produces a SQL load file containing a bunch of INSERT INTO statements. For textual analysis, I use variants of another script that builds a simple, navigable Web archive.

The Tool

Tools that marry Web forms to databases tend to assume, reasonably enough, that you're acquiring data directly into a database. They typically use templatized HTML forms containing triggers that read or write database fields. For a survey, however, it's convenient to separate data collection from database import—particularly when you're building both relational and textual databases from a common data set. Thus, there's no reason to use a template-oriented tool such as Cold Fusion or the Microsoft Internet Information Server (IIS) Internet Database Connector (IDC).

What's more, I've found that these products don't simplify database bookkeeping to the degree I'd like. They assume that you'll build both an HTML template and a corresponding database schema. You end up with two sets of field names that you have to maintain in sync. It's not a big deal, but life's short and I'm lazy, so I wrote form2db.pl (http://www.byte.com/art/download/form2db.pl) to generate a database schema automatically from an HTML form. This Perl script relies on the fact that browsers will quite happily ignore user-defined HTML attributes. For example, browsers render the input text box described by the following code:

```
<input type="text" name="email"
dbtype="char (50)">
```

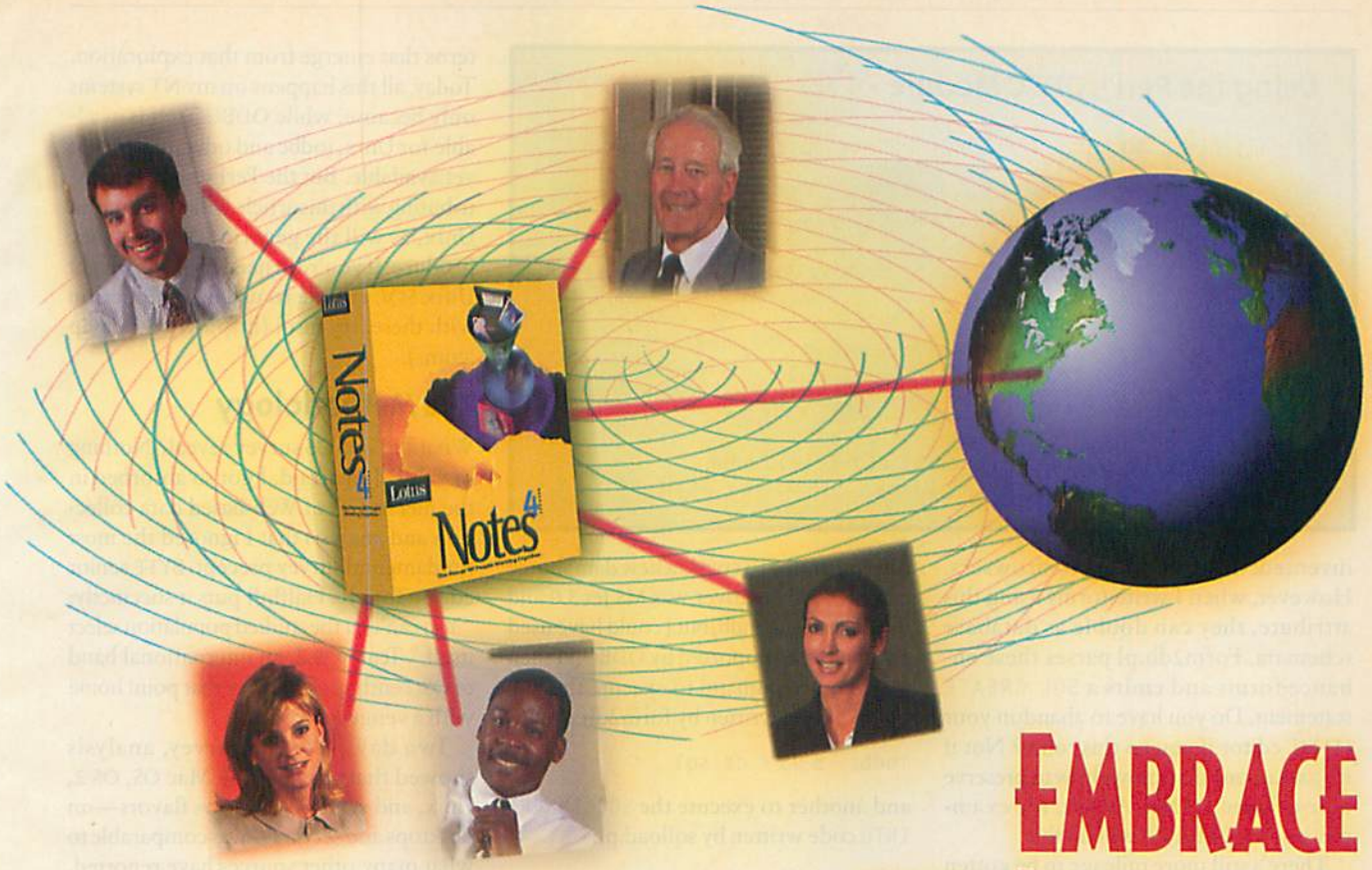
which is the same as

```
<input type="text" name="email">
```

The dbtype attribute, which I simply

TOOLWATCH

gnu-win32
(free at: ftp://ftp.cygnus.com/pub/gnu-win32/latest)
Cygnus Support
Mountain View, CA
http://www.cygnus.com
The gnu tools and libraries—gcc, bash, grep, bison, the lot—for NT (x86 and PowerPC).



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Using the Perl 5 ODBC Module

```
use NT::ODBC; $o = new NT::ODBC("DSN=os");

@use_cli = ('use_cli_mac','use_cli_os2','use_cli_w95',
'use_cli_nt','use_cli_unix','use_cli_w3x');
foreach $s (@use_cli,@use_srv) {
 if ($o->sql("select $s, count(*) from $view group by $s") !=
0)
    { die; };
 print "\n"; &printData;} }

sub printData {
 local ($data);
 while ($o->fetchrow) {foreach $f ($o->field names) {
  $data = $o->data($f); print $data . "\t"; } print "\n"; } }
```

invented, means nothing to browsers. However, when I write forms using this attribute, they can double as database schemata. Form2db.pl parses these enhance forms and emits a SQL CREATE statement. Do you have to abandon your HTML editor if you go this route? Not if it's a smart one that knows how to preserve user-defined HTML. Adobe, for example, says PageMill 2.0 will do this.

There's still more mileage to be gotten out of form2db.pl. I've said that I store each record initially as an ASCII-ized Perl associative array. That implies a CGI script, wired to the form, that writes the ASCII file. It's a simple CGI script—so simple, in fact, that form2db.pl can create it automatically. When I wrote the form for our OS survey, for example, I pretended that the script os.pl already existed:

```
<form action="os.pl">
```

When form2db.pl reads this form, it makes the imaginary script real. The single occurrence of the name os in the form tag drives several related processes. It becomes the name of the table created by form2db.pl's SQL CREATE output, the name of the file containing that output, and the name of the subdirectory in which os.pl deposits records. The figure "One Form, Many Uses" on page 133 summarizes these interactions.

The Analysis

In July's ToolWatch, I mentioned iodbc (ftp://ftp.digex.net/pub/access/psii/iodbc.zip), a command-line interface to the Open Database Connectivity (ODBC) subsystem on Windows 95 and NT. It's the thinnest-imaginable ODBC wrapper, and therein lies its strength. To load the OS survey data into a database, I used ODBC Administrator to create a new data source called OS. (The driver was MS Jet 3.0 and the format was .mdb, but I could have used any database supported by ODBC.) I then issued one command to execute the SQL CREATE code written by form2db.pl:

```
iodbc -S OS < os.sql
```

and another to execute the SQL INSERT INTO code written by sqlload.pl:

```
iodbc -S OS < os.lod
```

Then I launched iodbc in interactive mode to begin exploring the data set:

```
iodbc -S os
1> select count(*) from os
```

This approach makes me a knuckle-scraping Neanderthal or an avant-garde minimalist, depending on your perspective. I see it the latter way, because I find that operating a full-blown wizard-equipped GUI database can take more time and effort than just typing the small bits of SQL you need. What's more, as you write those SQL statements, you discover patterns—that is, opportunities to parameterize and automate SQL queries.

Perl coupled with iodbc is one way to exploit those opportunities, but it's awkward. Perl has to write SQL statements to a file, invoke iodbc on that file, and then parse iodbc's output. A better solution is odbc.pm, a Perl 5 module that makes ODBC SqlExecute and SqlFetch calls directly available to Perl programs. This has two major advantages: The SQL code doesn't have to take a trip through the file system, and its output comes back neatly chunked by row and column.

These two methods are complementary. I use iodbc when first exploring a data set and odbc.pm to codify the repeatable patterns that emerge from that exploration. Today, all this happens on my NT systems only because, while ODBC itself is available for Unix, iodbc and odbc.pm are not yet available. But the Perl scripts I'm distributing with this article will work fine on Unix, as will the generic SQL code they produce. If you're in need of a lightweight Unix SQL engine to use in conjunction with these, try msql (http://www.bunyip.com/).

The Methodology

What did our OS survey reveal? Nothing of value, I'm afraid. I got so absorbed in the mechanics of Web-based data collection and analysis that I ignored the most fundamental survey precept. BYTE senior editor Tom R. Halfhill puts it succinctly: "You can't let the studied population select itself." Team OS/2, an international band of OS/2 enthusiasts, drove that point home with a vengeance.

Two days into the survey, analysis showed that usage of the Mac OS, OS/2, Unix, and various Windows flavors—on desktops and servers—was comparable to what many other sources have reported. A few days later, Team OS/2 struck, and OS/2's numbers soared. An Alta Vista search of the Usenet uncovered one cause of the surge—a posting to comp.os.os2.advocacy, which contained the uniform resource locator (URL) of the survey page.

We reported the results in last month's Bits section on page 32. However, please don't quote the three pie charts, which show OS/2's dominance, without also quoting the portion of text showing that an OS survey response was 12 times more likely to come from the Internet domains ibm.com and ibm.net than was a typical BYTE Site visit.

We'll continue to run surveys on The BYTE Site. The anecdotal information we've gathered, for example from the ISDN survey, seems valuable as an indicator of trends and opinions. Quantitative data may have some limited value as well, on subjects charged with less religious fervor. However, we won't put much stock in the numbers until we can invite true random samples of participants, probably from a (yet-to-be-developed) site-registration database. For that valuable lesson learned, we have Team OS/2 to thank. B

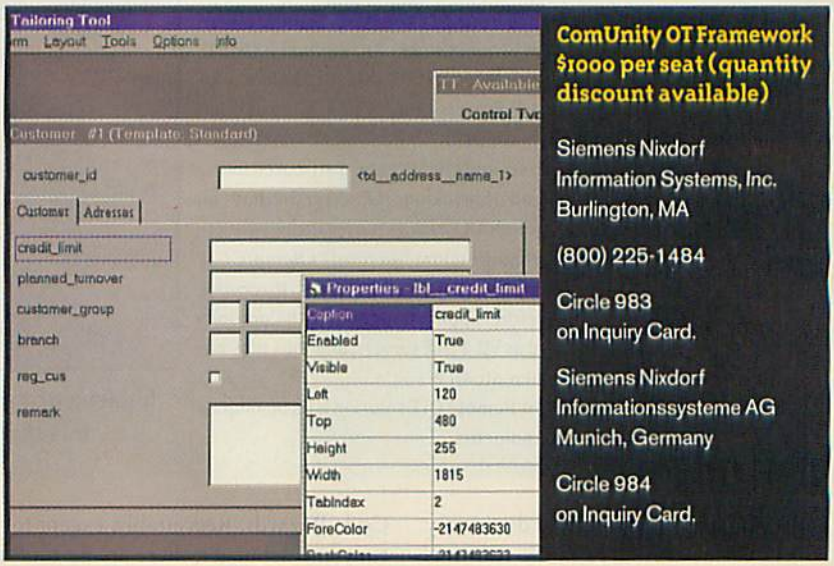
Jon Udell is BYTE's executive editor for new media. You can contact him at **jon_u@dev5.byte.com.**

Siemens Nixdorf's ComUnity aims to turn Visual Basic 4.0 into a client/server environment but falls short. By Volker Weber and Hans-Jochen Schmitt

Enterprise Visual Basic? Almost...

Although Microsoft markets the Enterprise Edition of Visual Basic 4.0 (VB 4) as an enterprise-level client/server tool, the product still lacks the high-level business-logic tools of such client/server mainstays as PowerBuilder.

Now, along comes Siemens Nixdorf, the German computer company, with a major effort to provide an overarching framework for client/server development that exploits VB 4's open programmable objects. Called ComUnity, the framework prescribes how to build distributed client/server applications. The related development environment is called the Open Technology (OT) Framework, which in its first incarnation works with VB 4. Siemens Nixdorf plans to port it to other languages, including C++. Our examination of a beta version revealed an ambitious product that nonetheless falls well short of its goals.



ComUnity OT Framework's Tailoring Tool lets users modify a custom application's UI.

Members of the ComUnity

ComUnity consists of a three-layer application model that comprises a Presentation Layer, a Business Logic Layer, and a Database Layer (see the Tech Focus figure on page 150). This model, like other three-tier architectures, offers advantages in scalability, usability, maintenance, and performance compared to monolithic applications. You can distribute the layers across a network, with the Presentation Layer on users' desktop computers, the Business Logic Layer on an applications server, and the Database Layer on a database server.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

To implement ComUnity's architecture in VB, Siemens Nixdorf had to employ Microsoft's standard development tools, including VB 4 itself, Microsoft Visual C++ 2.2, and OLE components. But because these tools are best suited for small-scale software projects, Siemens Nixdorf added more tools to improve support for large projects.

Inside the OT Framework

Central to OT Framework's Database Layer is a relational data dictionary that serves as a central repository where all the tables, attributes, and relations are managed. From the data dictionary, OT Framework generates Open Database Connectivity (ODBC) data sources, migrates databases, generates SQL statements for data access, and even produces simple entry forms for the user interface.

Unfortunately, even though you can manage the data dictionary with a simple data-entry and maintenance tool, OT Framework provides no graphical representation of the data-dictionary information. It does, however, import data models produced with CASE tools, such as Microtool's CASE 4.0 and IBM's Mood.

The data dictionary becomes part of the run-time environment repository that's distributed with OT Framework applications. Because the data dictionary contains information on the relationships between tables, applications can provide for relational integrity even if the underlying database has no such provisions.

The Presentation Layer, which establishes the user interface (UI), is built around VB 4. A forms generator uses the data-dictionary information to generate default VB 4.0 data-entry forms. You can customize these forms, but they also work with real data right out of the box.

OLE Automation acts as the glue between the Presentation Layer UI and the Business Layer. Perl scripts link code and single UI controls, but the program generates them automatically, so users don't have to deal directly with Perl. A cross-checker monitors the UI forms against

TECH FOCUS | ARCHITECTURE

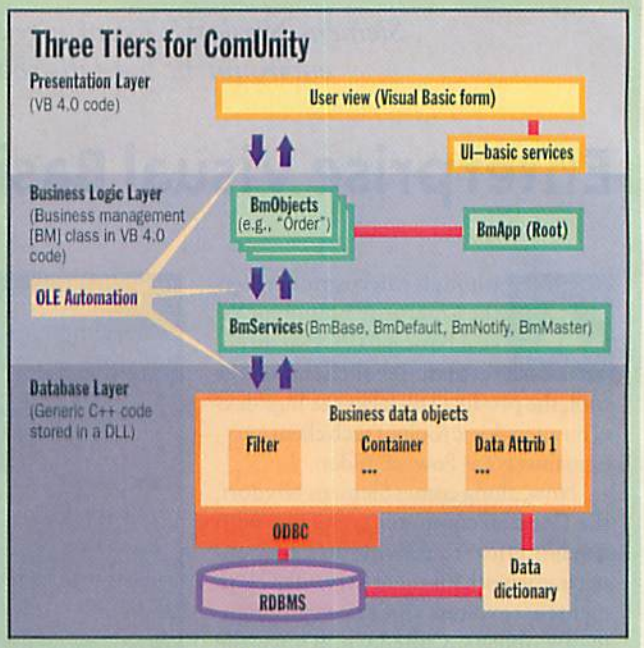
Linking Tiers with Remote OLE

Divide et impera (divide and rule)—splitting applications into three parts—is the state of the art in client/server technology. Modern client/server applications, such as SAP's R/3, use a Presentation Layer (for realizing the user interface) and a Database Layer (for storing persistent data), which are held together by a Business Logic Layer. For performance or maintenance reasons, the different layers can be implemented on distributed systems in a network.

To a programmer, the problem is not whether to split the application, but to choose a distribution technology that allows the parts to communicate over a wide range of networks and OSes. Remote procedure calls (RPCs), Common Object Request Broker Architecture (CORBA), and IBM's Distributed System Object Model (DSOM) are possible solutions. With Visual Basic 4.0 (VB 4) Professional Edition, Microsoft has offered yet another option: Remote OLE.

Remote OLE allows OLE servers and clients to be distributed over a Windows-based network. Instead of invoking OLE server methods on a local machine, the OLE client sends OLE requests over the network to a remote OLE server. Siemens Nixdorf chose Microsoft's Remote OLE as the primary communications technology for distributed, three-tier, client/server applications. Therefore, applications built with ComUnity OT Framework are implemented as VB 4 OLE servers, and thus they can be distributed fairly easily via Remote OLE.

The only catch to this elegant Remote OLE solution is its incompatibility with non-Windows environments.



Implementing ComUnity applications as OLE servers lets them communicate over a network.

any modifications in the data dictionary.

The forms are stored in the run-time repository, and you can use OT Framework tools to further customize the UI by working on the forms data. Users can use the Tailoring Tool (see the screen on page 149) to customize the UI: data-entry fields can be switched off, changed, or moved, even in the delivered version of an application. Developers who are skittish about giving users this much control over the UI can turn the tailoring tool off. Regardless of whether a site contains some highly individualized UIs, centralized program updates can merge with them seamlessly.

Putting It All Together

As the Tech Focus figure indicates, the glue between the UI and the database is the Business Logic Layer. OT Framework implements this layer in VB 4 code using the new VB 4 class concept. This pseudo-object-oriented feature allows you to define reusable classes and instances, but it doesn't support inheritance or polymorphism. OT Framework comes with predefined classes for UI handling and general-purpose business applications, such as order entry.

The application framework itself is a template-based VB data dictionary called Code Wizards. Regrettably, except for a run-time debugger, there are no tools in the Business Logic Layer—you're on your own as far as business processes are concerned. Thus, any higher-level knowledge must go from paper directly into VB code.

An Incomplete Toolkit

If you're not familiar with the VB environment, ODBC data sources, or tool-based software development environments in general, installing ComUnity can be a bit daunting. The beta version of the setup routine had some rough edges; the ODBC data sources for the data dictionary and the target applications are not added automatically. You must also add the VB Code Wizards and Form Wizards manually to the VB environment.

From a lone developer's point of view, OT Framework's major advantage is its vast library of reusable VB code for business applications software. The tool is rather loosely integrated with the VB environment. For small-scale projects, it does not go much beyond VB 4 or other add-ins and components that are on the market.

ComUnity also lacks an integrated version-control and project management tool. It relies on Microsoft Visual Source Safe, which comes bundled with the VB 4 Professional Edition, for version control. But Siemens Nixdorf says it's working to integrate Microsoft Project into a future version of ComUnity OT Framework.

Missing from this first implementation of the ComUnity architecture are integrated Upper-CASE tools, such as data modelers and object-oriented modeling tools. Sinking the whole business logic into pure VB code is asking for trouble, especially if users ask for changes in the application.

As long as you equate cross-platform development with Windows 95 and NT on Intel platforms, you'll have no problems with OT Framework. Its VB-centric approach restricts you to those platforms.

In the final analysis, ComUnity OT Framework caters to very specific needs. If you're a VB developer building large-scale business applications and are willing to learn a new application framework, give version 1.0 of ComUnity OT Framework a closer look. Everyone else should take a pass on it for now. B

Volker Weber and Hans-Jochen Schmitt are principals at ifos, a consulting firm in Darmstadt, Germany. They can be reached at **100120.577@compuserve.com**.

EXPLORING...

The EXPLORING series is a multi-media collection for Secondary School students, designed specifically to help them learn in a simple and intuitive manner. It is not intended solely for students but also for anyone wanting to increase and broaden their knowledge of a specific subject. The user can learn all the information either by following the topics step by step or by navigating through the contents. Learning is pleasant and the results are guaranteed thanks to particularly sophisticated multi-media techniques, such as the use of graphics for a more effective understanding of the contents, hypertext links for moving from a given topic to other related ones and helpful functions for searching for the best-known terms.

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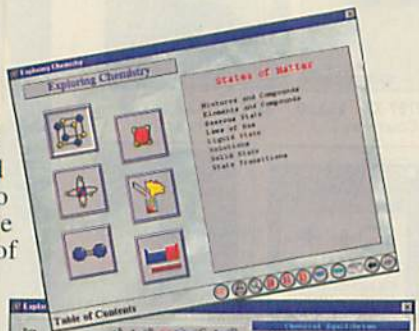

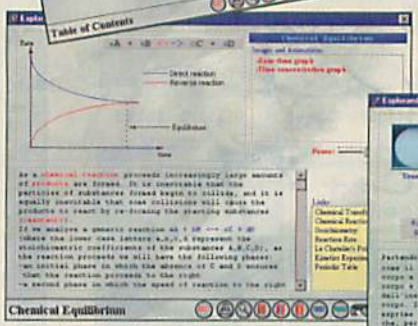

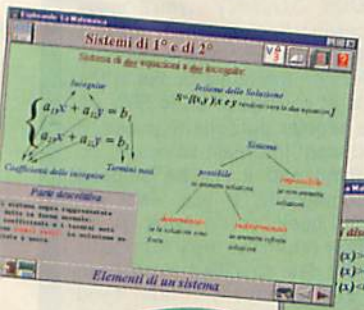

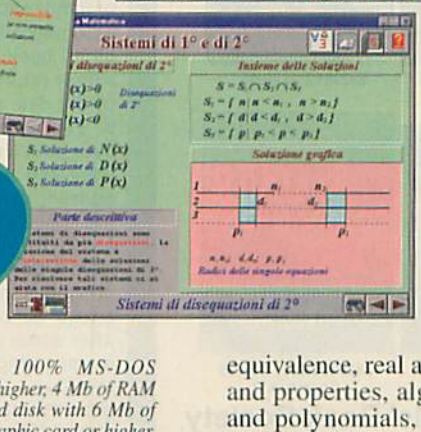

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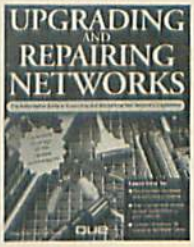

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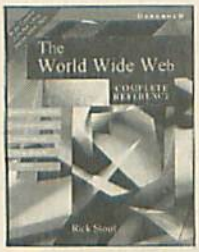

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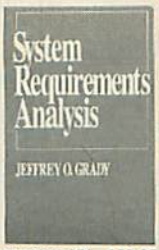

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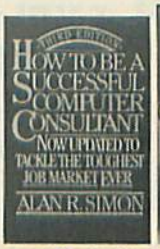

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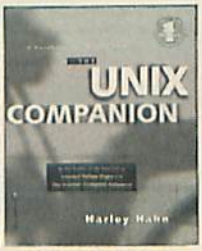

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Powersoft's Optima++ makes C++ client/server development a drag-and-drop dream. By Rick Grehan

A C++ Tool That Cures VB Envy

In spite of all the complaints about Visual Basic (it's slow, it's only somewhat object-oriented), you have to love how easy it makes building user interfaces (UIs). Wouldn't you like to have the same building-block-style environment in a C++ package?

Powersoft's Optima++ is about as close as you'll get... for now. It is a rapid application development (RAD) system for Windows 95 and NT that incorporates the best of current Windows development systems. Look at who's contributed genetic material to its conception: Watcom, producer of one of the best C/C++ compilers for Intel platforms; Sybase, a database organization of considerable repute; and Powersoft, creator of the PowerBuilder fourth-generation language (4GL) development system. The result is a combination UI builder, client/server database construction kit, and general-purpose C/C++ compiler that will probably have Delphi and VB developers sneaking peeks over the shoulders of Optima++ users.

Just Up the Road

Soon-to-be-released editions of Optima++ will include:

- Sybase SQL Anywhere (four-user version)
- Internet components
- Integrated support for Java
- Team programming
- Native database drivers

Cultured Drag and Drop

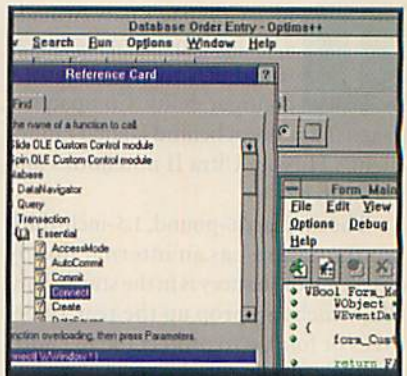
Optima++'s most elegant feature is without doubt its drag-and-drop programming. The designers have turned on-line help into a *reference card*, a kind of souped-up hierarchical help system structured in outline form. The upper-level branches of the outline consist of the object categories understood by Optima++: database objects, graphics objects, menu objects, and so forth. The leaves are the object methods.

The reference card is much more than a static help mechanism. For example, associated with any visual object (say, a button) on a form is source code for handling events that the object receives. Open a window to that source code, grab any other visual object (say, a listbox), and drag that object into the source code window. This will cause Optima++ to open the reference card, properly positioned to the methods associated with that listbox. With just a few more mouse-clicks, Optima++ will automatically write the source to invoke the selected method for you.

Components and C++

Drag-and-drop programming is only part of Optima++'s allure. Because it uses a construction-by-components paradigm, you'll find nonvisual components as well as visual ones (e.g., database query components and transaction components). Optima++ can also incorporate OLE Controls (OCXes) into its component toolbars, which means it also creates entries in the reference card for each OCX. Consequently, you manipulate OCXes in the same way as the native components supplied with Optima++.

Finally, because Optima++ is, after all, a C++ development system, it wraps a number of system services in easy-to-handle classes (e.g., thread objects). Its debugger is as full-featured as any I've seen, going so far as to include a memory tracker, which can locate a number of memory-related bugs. The memory tracker's coverage ranges from simple leaks to more elaborate validity checks on objects such as strings and Graphical Device Interface (GDI) handles.



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What's Ahead

At the time of this writing, only Optima++'s Developer Edition was in release. Professional and Enterprise Editions will appear soon (see the text box "Just Up the Road"). If the upcoming editions are as well done as the Developer Edition, they could well be the stepladders that many VB developers need to begin their ascent to the otherwise frightful altitudes of C++ programming. B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★ ★

Rick Grehan is senior technical editor of BYTE reviews. You can reach him on the Internet at **rick_g@bix.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

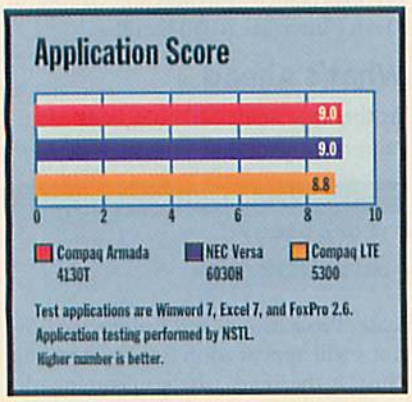
With Compaq's Armada 4100 family, you build the notebook you need. By Dave Rowell

Notebook Under Construction

I love Compaq's new Armada 4100 notebooks for many reasons, but particularly for their configurability. Compaq has taken the concept behind Digital Equipment's HiNote Ultra II notebooks and run with it.

The standard 6-pound, 1.5-inch-thick configuration has an internal floppy drive, but the battery is in the sturdy handle, which can prop up the rear 10 degrees or fold up to protect the I/O ports in transit. Remove the handle and replace the modular floppy drive with a $199 battery module, and you have a 5-pound slim-line notebook. Two screws with D-ring loops make the handle attachment easy and secure.

Going the other way, you can attach the optional $399 CD-ROM base and have an 8.2-pound multimedia notebook. The base holds a 4× CD-ROM drive, two more (larger) stereo speakers, and a bay for another battery. Remove the floppy drive, and the notebook can hold three lithium-ion batteries for a really long flight.



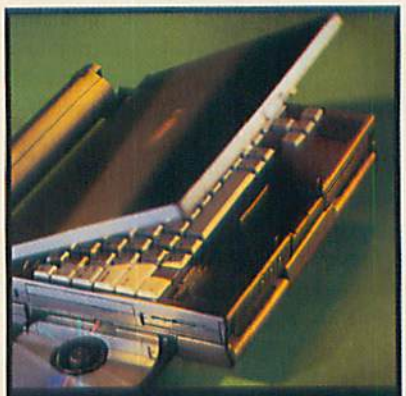
In any configuration, an Armada 4100 is bulkier than a HiNote Ultra II, but it's also more functional, holding floppy and CD-ROM drives simultaneously, for example. The Armada's magnesium-alloy frame gives it strength and conducts heat from the processor. Compared to Compaq's larger LTE 5000 series, the Armada 4100 notebooks lack the option of a full docking station with drive bays. They can, however, attach to a port-replication base (with or without the CD expansion unit) that has an Ethernet port.

Pricing is competitive, starting at $2599. I tested the high-end Armada 4130T, which costs $4599 and includes a 133-MHz Pentium, 16 MB of RAM on the system board, an 11.8-inch active-matrix color display, and a 1.08-MB hard drive (the current maximum). With the CD-ROM expansion base and an extra battery, I was up to $5197. You can add up to 32 MB of additional RAM using two dual in-line memory module (DIMM) sockets. All models come with 256 KB of 9-nanosecond static RAM (SRAM) cache, a PCI bus, full video and audio ports, speakers and a microphone, an infrared port, and zoomed-video-enabled PC Card slots.

Displays are upgradable. Compaq designed the 4130T's 11.8-inch, 800- by 600-pixel active-matrix color display with a limited horizontal viewing angle, which is better for plane flights than conference rooms. Less expensive models can have 10.4- or 11.3-inch dual-scan displays. You get your choice of pointing devices. Armada 4100 notebooks come standard with a Cirque-type touchpad, but you can order it with a trackball and swap out one for the other.

The four programmable keys along the top left of the keyboard are surprisingly useful. A Compaq extension to the keyboard control panel lets you assign a program to each key, choosing from a list of all runnable programs. You can press a key to launch Explorer, for example.

Compaq adds some nice touches to the Windows 95 environment. A slick power management control panel offers many sensible options, like AC power management, that are easy to figure out and modify. Compaq's diagnostics program tells you more things about your computer than you'll ever want to know.



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In performance, the Armada 4130T ties the NEC Versa 6030H, the performance winner in this month's NSTL Hardware Lab Report (see page 114). In design, Compaq has really hit a sweet spot. I expect the Armada to be both admired and copied. B

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★★
PERFORMANCE	★★★★★

Dave Rowell is a BYTE senior technical editor who handles hardware reviews. You can reach him at **drowell@bix.com.**

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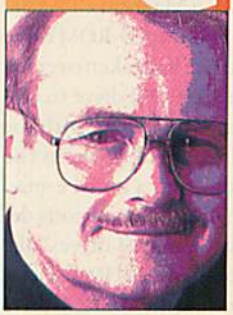

Of Zip and Spam and NT 4.0

Jerry finds new uses for removable drives—once he gets SCSI drive assignments under control.

The worst prediction I ever made was that using spinning metal for mass storage would go away. "Silicon is cheaper than iron," I said. That hasn't happened. Mass storage, like memory, has become so cheap that anyone who loses work because it wasn't backed up deserves what happened.

You can add mass storage by getting a big hard drive and adding it to your system. That's worth doing, but there's an easier way.

The Iomega parallel Zip drive has become something between a standard and a necessity. Attach it to the parallel port of any PC, run one "guest" program from a floppy disk or your hard disk, and you have a 100-MB removable-cartridge drive to use for backup and file transfer. It's extremely well behaved, attaching itself as the next unused drive letter, and it leaves no residual problems when you disconnect it.

The last time I talked about the parallel Zip drive, I casually said "alas, no Mac." Since a Mac has no parallel port, that seemed obvious enough. I have since got a ton of e-mail, some polite, reminding me that the SCSI version of Iomega's Zip drive works just fine with Macs.

Some of the mail was nasty. I know a columnist who swears he will never again mention Macs because he's weary of the hate mail he gets whenever he writes anything but fulsome praise about the Mac. Although I guess I have a bit thicker skin, really, people, you do your cause no good this way. Save your hate mail for your enemies, or better yet, for archiving before you send it.

Anyway, I have a SCSI Zip drive, and, indeed, it works with Macs. With System 7.5's PC Exchange (or a similar utility), the Mac can read DOS-formatted Iomega disks, so you can use the Zip drive as a convenient sneakernet with backup for transferring data files between Macs and PCs.

The SCSI drive is a lot faster than the parallel drive. It took 6 minutes to transfer 44 MB (some big files, lots of small ones, a complex subdirectory structure) from a hard drive to the parallel Zip drive; doing the same operation with the SCSI Zip drive took just under 2 minutes. Writing that 44-MB directory from the parallel Zip drive to a hard drive took about 5 minutes, as opposed to about 1½ minutes with the SCSI Zip drive. If you're after speed, or you want to transfer from a PC to a Mac and back, clearly you'll want the SCSI version. On the other hand, if what you want is backup and convenient file transfer among PCs, the parallel version is preferable.

Anyone who loses work because it wasn't backed up deserves what happened.

The SCSI Zip drive will run off any standard SCSI controller, or you can buy Iomega's SCSI controller card, which appears to be a standard Adaptec SCSI-1 card. Installation for using it with the Zip drive is well documented. My advice is to get an Adaptec SCSI-2 card, but the Iomega card will certainly work. Installation of a SCSI card is simple provided you have a free interrupt request (IRQ). DOS-only systems don't need an IRQ.

For my first test, I connected the SCSI Zip drive to the SCSI outlet of the Distributed Processing Technology caching drive controller on Pentafluge, the Pentium 60 system we built a couple of years ago. This is an older controller that requires a jumper setting to activate the external SCSI port. I long ago set it to make the external port active and keep a Granite Digital SCSIVue Active Diagnostic Terminator on the port when no other device is attached, so I don't have to go inside Pentafluge to install a SCSI string.

It would have been a lot simpler if I'd had the right cable; alas, the SCSI output on Pentafluge's controller is a standard 50-pin SCSI-2 connector, while the Zip drive wants a DB-25 cable. The cable that comes with the SCSI Zip drive is a male-to-male DB-25 that looks exactly like a heavy-duty parallel-port cable.

Of course, the potential for accidentally plugging the SCSI Zip drive into a parallel port, or the parallel Zip drive into a SCSI port, is pretty high. I don't know what would happen, but I sure wouldn't want to try it.

Pournelle's first law of making SCSI work: start with Granite Digital SCSIVue Gold Diagnostic Cables and don't change to anything else until you have everything working properly. Granite Digital makes the High Density MicroD 50/DB-25 Cable, a SCSI-2-to-DB-25 cable, but I didn't have one and didn't want to wait. Thus, I connected the Pioneer DRM-624X six-disc CD-ROM changer to Pentafluge with one Granite Digital cable and used a Granite Digital 50 Centronics/DB-25 Cable to daisy chain the SCSI Zip drive to that. The SCSI Zip drive has a switch on the back to set termination: it was the last drive in the SCSI string, so I set it to "on."

The Zip drive also has a switch that sets it as SCSI ID 5 or 6; I set it to 6. Then I brought up the system with no cartridge in the drive and with the DRM-624X turned off and thus inactive. *continued*

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Windows 95 (Win 95) came up fine, ignoring the DRM-624X as it should. There was one hitch. Pentafluge has logical hard drives C and D, a Maxoptix T3-1300 optical drive as E, and the CD-ROM drive as F. The SCSI Zip drive had taken over the F slot, moving the CD-ROM drive to G. I described a similar experience with the Syquest EZ135 SCSI hard drive in the June column. I got quite a bit of e-mail from people telling me, with various degrees of politeness, that SCSI drives take over in the order of their SCSI ID number, so I'd hoped that setting the SCSI Zip drive to ID 6 would prevent that shift. Alas, that turned out not to be the case.

Once I had the SCSI Zip drive operating, I timed some massive file transfers across the network and then shut down the system.

I got the "Please Wait" message. After about 5 minutes, it was pretty obvious that nothing else would happen, so I cut the main power. When I turned it back on,

The system came up on the third try, and Lo!, the drives were really out of order.

Pentafluge trundled for a while and then Win 95 announced there were problems with the Registry. It offered to restore the Registry from backup and try again, warning me that I might lose something in the process. There didn't seem to be much of an alternative, so I told it to go ahead.

I got the same message once more, and once more told it to go ahead. Recall that the first time I brought up the SCSI Zip drive, I did so with no cartridge in the drive. I had forgotten that, and there was a cartridge in the drive this time.

The system came up on the third try, and Lo!, the drives were really out of order. The D drive, which is merely a logical partition of a single physical drive, had been moved and the SCSI Zip drive had taken over D. E was still the Maxoptix T3-1300, F was now the D drive, and the CD-ROM drive that normally lives at F was now G. All those drives worked in the sense that I could access them, but any software that expected the D drive to be D was hosed.

Shut down once more. This time, it shut down with no problem, and I have been unable to duplicate the shutdown problem on any machine since that first time. I've no idea what happened. Anyway, I removed the cartridge from the SCSI Zip

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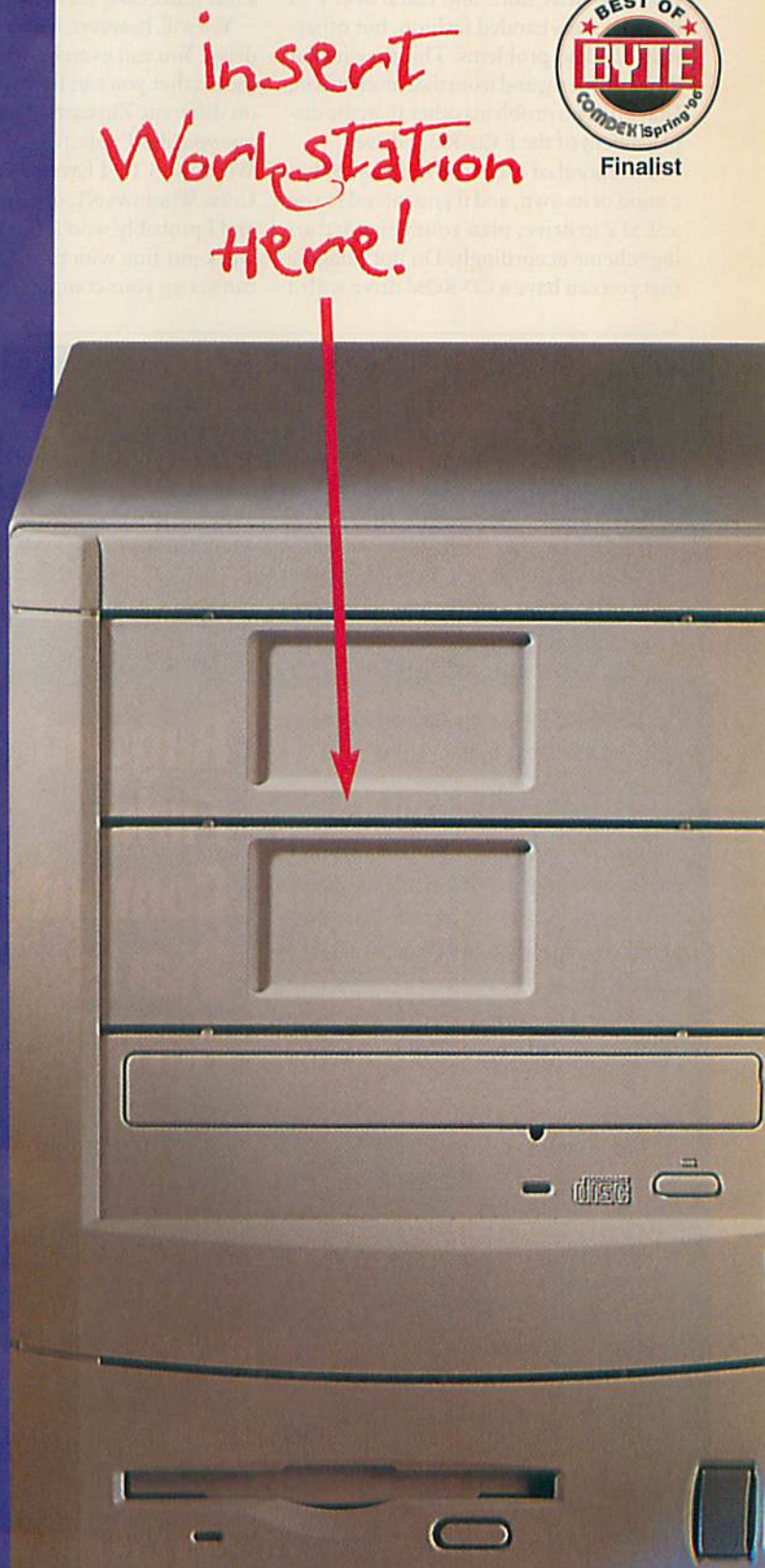

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Circle 155 on Inquiry Card (RESELLERS: 156).

drive and fired up once more. It came up fine. The D drive was once again D.

Of course, the Zip drive had shoved the CD-ROM drive aside and taken over F in its usual high-handed fashion, but otherwise I had no problems. This time it shut down properly, and from that moment on, I have had no problems other than the displacement of the F CD-ROM drive.

The moral of this story is that SCSI has a mind of its own, and if you intend to use a SCSI Zip drive, plan your drive-lettering scheme accordingly. Do not imagine that you can have a CD-ROM drive with a lower drive letter than the SCSI Zip drive; and if you plan to boot up your system with a cartridge in the drive, be prepared for some other oddities in drive lettering.

You will, however, have a perfectly good drive. You can even boot from it, which means that you can have a series of OSes on different Zip cartridges and boot the one you like. I've tested it with Win 95 and Windows 3.11. I haven't yet tried it with Unix, Windows NT, or any flavor of OS/2, and I probably won't; but I'm told it will work just fine with those, too, since you can set up your computer to believe that the SCSI Zip drive is just another Winchester hard drive. Incidentally, that's also true of the Syquest EZ135.

One possible configuration is to have a hard drive as the data drive. Set it as a non-primary drive and then set a Zip drive as the C boot drive. Then you can boot any OS you like by changing cartridges.

Once I was sure the SCSI Zip drive worked on Pentafluge, I transferred it to Cyrus, my Cyrix 6x86-P166 system. Cyrix claims their P166 is completely compatible with, and faster than, a Pentium running at 190 MHz. I've used the Cyrix system for a couple of months now, and I have no reason to dispute that claim. It is fast, compatible, and reliable.

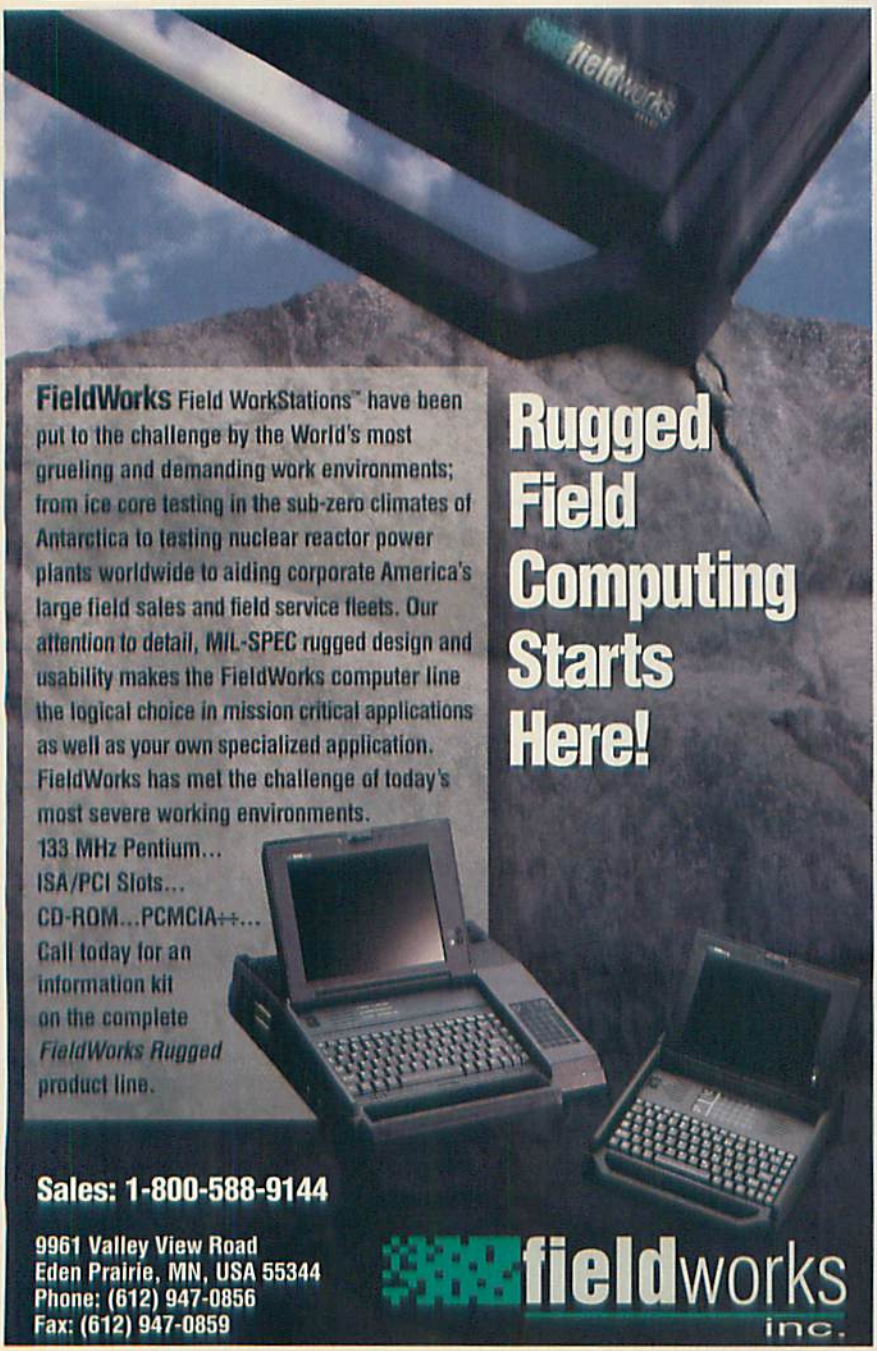
Cyrus has a PCI-bus Adaptec SCSI card with an external SCSI-2 connector port, so I moved the DRM-624X and SCSI Zip drive string over to it, and booted up with the DRM-624X turned off and no cartridge in the Zip drive. It came up fine. Cyrus does not have a Maxoptix optical drive, so the CD-ROM drive is E. As expected, the SCSI Zip drive displaced it, taking over the E slot for itself and moving the CD-ROM drive to F.

You can have a series of OSes on different Zip cartridges and boot the one you like.

Unlike Pentafluge, Cyrus had a network drive mapped to F, but that didn't matter. The SCSI Zip drive became E, the CD-ROM drive became F, and the F network connection vanished. Actually, it didn't quite vanish. While I could read the CD-ROM drive as F, when I went into My Computer and looked at network drive connections, the pull-down menu still showed F as a network connection.

Shutdown was normal, and booting up with a cartridge in the Zip drive produced no different result from when there wasn't a cartridge. That is, while booting with a cartridge displaces the D partition on Pentafluge, it doesn't do that on Cyrus. No one I've spoken to can tell me why.

The next step was to connect both Zip drives to Cyrus. They worked fine, with the parallel drive taking the next empty drive letter (G), while the SCSI drive displaced the CD-ROM drive as usual. Finally, I turned on the DRM-624X, leaving both Zip drives attached to Cyrus. Everything worked. The SCSI Zip drive took over E; the internal CD-ROM drive became F; the



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DRM-624X took over G, H, I, J, K, and L; and the parallel Zip drive took the lowest unused drive letter after L.

The interesting thing about this is that several of the drive letters between F and L had been mapped to other network drives. Those network connections simply vanished—except that their ghosts remained in the network setup, and booting up with the DRM-624X turned off restored them.

The bottom line here is that both parallel and SCSI Zip drives work quite well. They read each other's disks just fine. The parallel Zip drive installs simply and works unobtrusively, finding an unused drive letter for itself.

The SCSI Zip drive installs easily if you already have SCSI devices; otherwise, you will have to install a SCSI card and drivers. This isn't particularly difficult, but it's certainly harder than just connecting a cable to the printer port. The SCSI Zip drive is more aggressive and will certainly displace a CD-ROM drive if brought up with a cartridge in the drive, and it may even displace a hard disk partition. You are unlikely to prevent this no matter how hard you try. Otherwise, no damage is done.

The SCSI drive is about three times as fast as the parallel drive and perhaps half as fast as your average hard drive. Either can be a good way to add storage capacity to your system. I particularly like the parallel Zip drive as a backup-and-sneaker-net system, but, of course, unlike the SCSI Zip drive, you can't use it with a Mac. The SCSI drive works well with both Macs and PCs. If you need storage space and a backup system, either is pretty hard to beat. Recommended.

Having said all that, I have to point out that I have for about a year had a Fujitsu DynaMO 230 magneto-optical (MO) system attached to a SCSI port on an ancient Cheetah 386. I've used it across an Ethernet, and it's about as fast as the SCSI Zip drive. It has always been reliable. Nothing in the Fujitsu literature mentions using this on a Mac, but SCSI is SCSI, and I'd be astonished if you couldn't connect the DynaMO 230 to a Mac. What you won't do is read the DynaMO cartridges on a parallel-port device. Still, the DynaMO 230 works. The drive and cartridges are smaller than the Iomega Zip drives and their cartridges, and each DynaMO cartridge holds a bit more than 200 MB compared to the Zip drive's 100 MB.

I had hoped that Merlin, the newest version of Warp, would be able to make use of the Doubleshot 133's dual processors.

We installed the beta version of NT 4.0 on the Doubleshot 133, which had previously been running NT 3.51. At one time, it ran OS/2, and I had hoped that Merlin, the newest version of Warp, would be able to make use of the Doubleshot 133's dual processors, but IBM didn't put that feature in Merlin. IBM is beta-testing SMP for Warp Server. For now, to run OS/2 with symmetric multiprocessing (SMP),

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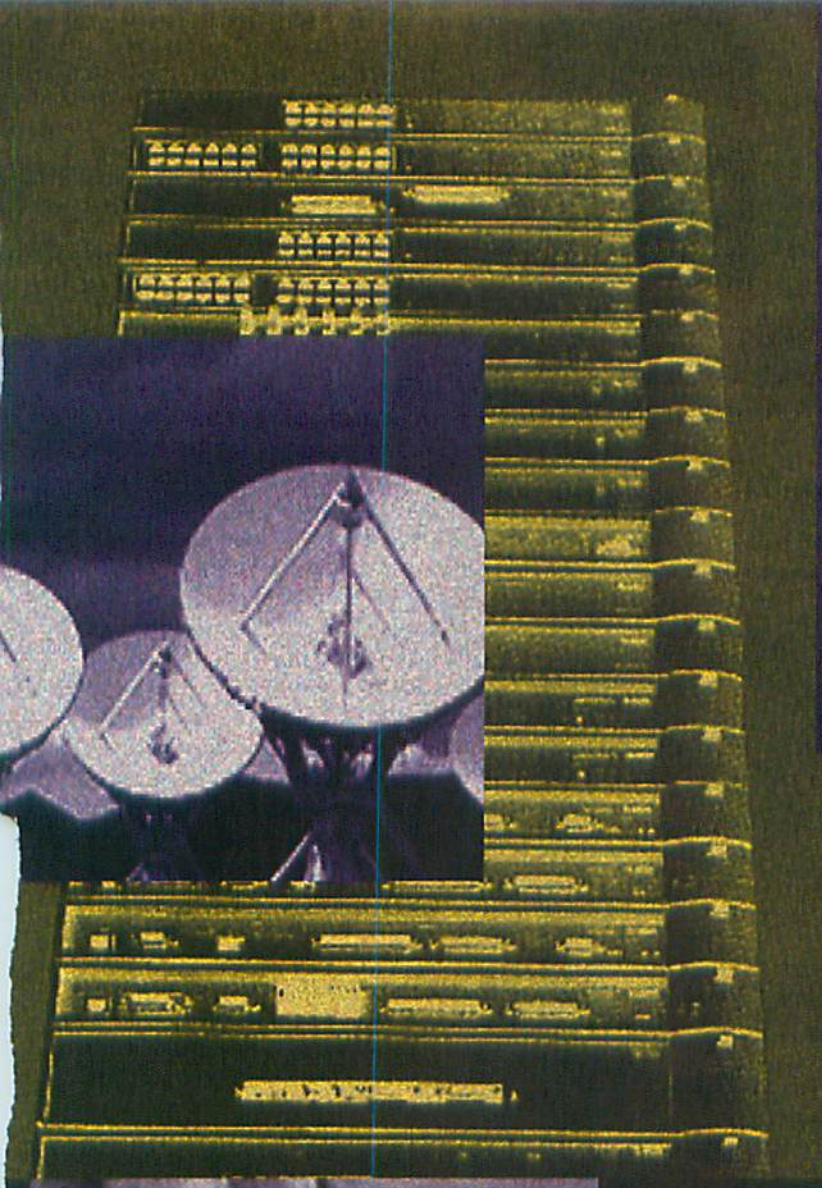

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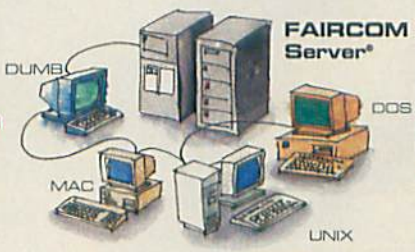

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you are stuck with clunky OS/2 2.11. While I rather like OS/2 Warp Connect, and I think I like Merlin, I refuse to go back and relearn version 2.11.

Installation of NT 4.0 was really simple on the Doubleshot 133. I haven't yet tried installing it on a machine running Windows 3.1 or Win 95; I'm told that's a bit more difficult, but nothing excessive. One thing, though: be sure you know the IRQ and port address settings for all your hardware. Unlike Win 95, NT doesn't even try to be Plug and Play. On the other hand, it won't change your settings for you once you have them the way you like.

We haven't done a lot of work with NT 4.0, but what I've seen I like a lot. It's much more like Win 95 than 3.11. In fact, you can use NT 4.0 quite a while before you notice it isn't Win 95. It's also faster. Although few current applications have threaded code able to take advantage of the Doubleshot 133's dual processors, ordinary single-threaded jobs are still faster because NT 4.0 is able to trade off between processors, putting all the background stuff like network and disk operations, monitoring the uninterruptible power supply (UPS) status, etc., on one processor while the other runs your task.

In practice, it's not quite that simple. NT 4.0 has a utility that shows a graph of processor-use history. There are two such graphs for a dual-processor system, and it's interesting to watch how NT switches loads between processors as you load it down by networking to the server.

There was a time when OS/2 was a technically more elegant OS than NT, and OS/2 Server was about the best server software around. I don't think that is true any longer; IBM long ago lost the marketing edge and may now have lost the technical edge as well. NT 3.51 is very stable and makes for a good server system; while NT 4.0, even in the beta version, is fast, easy to use, simple to install, and looks like Windows to most of your network. Moreover, IBM is rapidly adapting its server software to run just fine on NT systems. If you have a large computer network system and the resources to manage it, you may have a need for OS/2; but NT 4.0 seems to be the NT for the rest of us. More when I know more, but my first impressions of NT 4.0 are very positive.

Meanwhile, the little Doubleshot 133 remains the quietest system in the house. It's very stable, and running NT 4.0, it may be the fastest networked system we have

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here. Those dual processors really speed things up. Just now, it is the NT experimental machine, but once I'm sure NT is stable, I think I'll put the Micropolis external 4-GB drive on the Doubleshoot 133 and make it the main Chaos Manor server.

Visioneer's PaperPort Vx is a blooming little miracle.

This is a gadget about 4 inches tall, 3 inches deep, and a foot wide. It sits anywhere you like and connects to a serial port with a normal cable. Once installed, you activate it by feeding it a sheet of paper. It reads your papers, one sheet at a time, into image files, one file per sheet.

Installation was simple: I plugged the PaperPort Vx into the COM1 serial port, connected its power supply, and ran the installation program. The software seems to have scanned my system, because when it was done, the PaperPort "desktop" had icons for Microsoft Word and WinFax, as well as "printer," Exchange, Excel, WordPad, and Paint.

I fed in a printout of some e-mail I'd received on BIX. The PaperPort Vx pulled it through and quickly made an image file of the document. Then I dragged the image onto the WinFax icon and sent it to my fax machine downstairs. It came out quite readable, as good as any fax comes out on my old thermal fax machine.

Then I dragged the image onto the Microsoft Word icon. That automatically activated the OCR to produce a Word document. It made one mistake: the original said "pc." The OCR read that as "pe."

I've also fooled around with other stuff. There are a bunch of settings to get different qualities of OCR performance and image quality. It's all quite intuitive, and now I've got electronic versions of some newspaper articles I've been saving, meaning I can find them by electronic search now. I think I'll do a lot more of that.

I had one major glitch. Once when I fed in a sheet of paper, the electric fan blew it about as it emerged, and the program said the read had failed, although examination of the document image didn't show any problems. After that, though, the PaperPort Vx wouldn't feed paper at all, and the software kept telling me there was no PaperPort device on COM1. I even tried turning off the computer and bringing it back up, and still the Visioneer software insisted there was no PaperPort on COM1. Finally, I turned off the PaperPort itself by pulling its power cord. That worked: it processed the next sheet of paper I fed it just fine. Apparently that "reset" it.

Visioneer also makes a keyboard with a PaperPort built into it, called the PaperPort ix. It has a separate power supply, so presumably you can "reset" it the same as with the stand-alone version. I'm fairly picky about keyboards, so I haven't tried it yet, but I'll have one of the interns install it at his station. I'm sure it will work; my only question is whether I'd like the PaperPort ix as a keyboard. More another time.

Disk space keeps getting cheaper. You can put a lot of documents on a 100-MB Zip cartridge; and that's a lot of paper you don't have to keep around. My son Richard uses a PaperPort to keep his paper files small, and it sounds like a good habit to get into. I expect I'll be writing about this again.

You'll have noted that my primary e-mail address remains jerryp@bix.com. BIX began as the BYTE Information Exchange and was eventually sold by McGraw-Hill to Delphi, which was later bought by News Corp. Recently, a group of Delphi/BIX employees with some outside backing bought both BIX and Delphi

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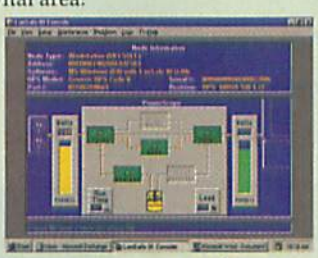

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and are making a going concern of both.

BIX isn't for everyone. It's small, and the interface is text-based and command-line-driven. It looks old and clunky. The appeal of BIX is the information density. BIX never exploded the way the Internet did, and as a consequence, there are intelligent technical conversations and very little spam. When you ask a question on BIX, you get a reliable answer.

My usual access to BIX is through a shareware program called Galahad. This is a Windows/Win 95 program that goes out to BIX, logs on, downloads all my e-mail and all the message traffic in the conferences I belong to, and then logs off, letting me deal with everything off-line with reasonable text editors. It's one of the main reasons I stay with BIX.

The main problem with Galahad has been using it on multiple machines. Galahad keeps all kinds of reference files, archives, and databases, and transferring all that when I want to use a different machine is a major pain. Then, just today, on BIX, BYTE technical editor Russell Kay suggested the solution: put Galahad—program, logs, files, and all—on a Zip cartridge. Carry the Iomega parallel Zip drive in checked luggage—a good idea for a backup system since I do a lot of work on the road—and access BIX that way. When I get back home, I attach the Zip drive to the parallel port of the system I'm using.

I haven't tried this, but I will. I'll probably go even further: since I have five Internet accounts and three e-mail boxes, I'll put all that Internet stuff on a Zip cartridge. Working out a backup system shouldn't be too difficult. Yet one more use for the parallel Zip drive.

Meanwhile, BYTE readers weary of the bickering and nonsense in much of the Internet might think about BIX, where all conferences are moderated and most of the participants really do know what they're talking about.

Two vital books for computer pros: *The Hard Disk Data Base* and *The BIOS Companion*, both by Phil Croucher, and both exactly what their titles imply. If you work with odd computers, particularly older ones, these are invaluable: page after page of technical data, all in one place.

The game of the month is the Strategic Studies Group's The Complete Carriers at War. All the older Carriers at War games and construction tools, plus new scenarios, including the North Atlantic and Mediterranean. Suppose the Germans had gotten control of the entire French navy: could the British have beaten the combination? Plus the entire Pacific carrier war. Lots of realism and no arcade action.

The CD-ROM of the month is The 1996 Grolier Multimedia Encyclopedia. It's well balanced between details and brevity. Philip Jose Farmer defined a dullard as a person who can go to the encyclopedia, look up one item, read it, and close the book. It's fun to browse Grolier.

The book of the month is by Cicely Veronica Wedgwood, *The Thirty Years War* (Routledge). I thought I knew all I wanted to about the Defenestration of Prague, Friedrich the Winter King, Father Tilly, Cardinal Richelieu and Father Joseph "the gray eminence," and Wallenstein, but once I opened this wonderful book, I found a wealth of details more fascinating than any

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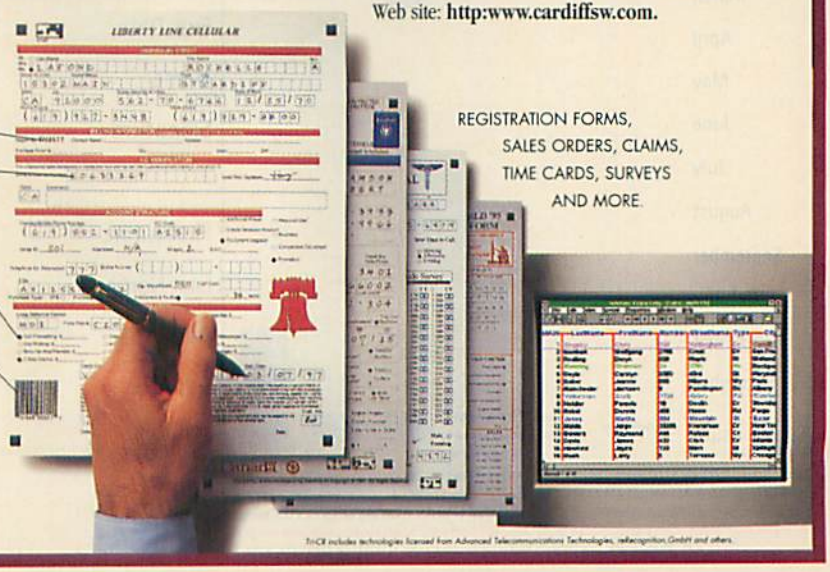

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novel. Part of Hitler's popularity came from his promise to upset the Peace of Westphalia that ended the Thirty Years War.

The computer book of the month is by Gary Frerking, Nathan Wallace, and Wayne Niddery, *Borland Delphi How-To* (The Waite Group). I've neglected Borland Delphi in my language discussions, and I shouldn't: it's a practical language every bit as useful as Visual Basic, and, being rooted in Pascal, it has a more logical structure. The book teaches through examples and includes a CD-ROM with hundreds of subroutines that are useful in themselves as well as worth studying.

A computer book I overlooked when it first came out is Susan A. Kitchens' *The KPT Bryce Book* (Addison-Wesley). Bryce is the landscape-generator software portion of the Kai's Power Tools series; Kai's Power Tools are one of the reasons Mac computers are so much fun. Kitchens starts with basics and explains how to build structures, from castles to planets, with examples, including the inevitable CD-ROM of routines and pictures. If you use a Mac, you'll like this.

As usual, I've written more than will appear in the magazine. You can find it on BYTE's Web site. You might also want to check out http://www.earthlink.net/discontinuity, where John C. Dvorak and I argue critical issues. B

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Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com.**

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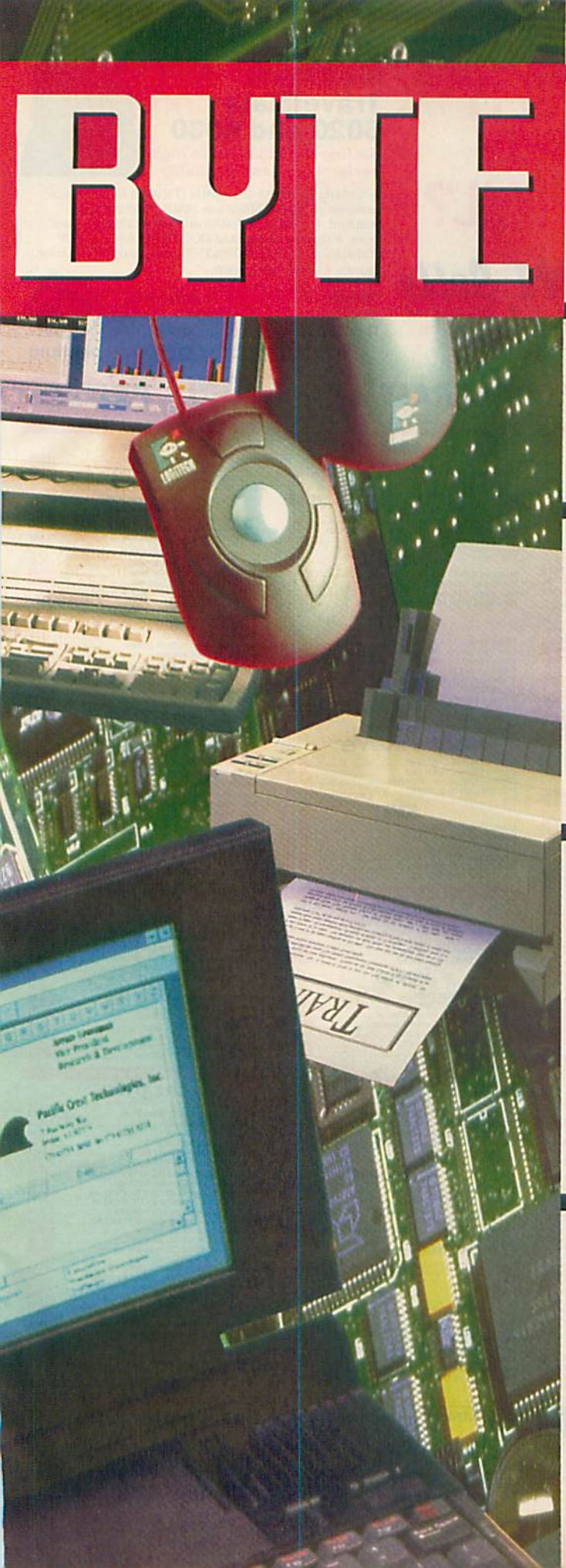

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SuperStack II Hub 12-port 100BT	1629.99
SuperStack II Hub 48-port 100BT	5976.64
SuperStack II Switch 1000 12-port Enet	2491.73
SuperStack II Switch 1000 24-port Enet	3117.21
SuperStack II Hub TR 12-port	1192.51
SuperStack II Switch 2000 TR 12-port	5349.47

Bay Networks

BayStack 12-port hub 10BT	592.16
BayStack 24-port hub 10BT	1053.70
BayStack 12-port hub 100BTX	1555.51

NETWORKING PRODUCTS

Artisoft

LANtastic V7.0

Starter kit 3.5" + CD	245.54
Add-on kit 3.5" + CD	128.53
1-user comp upg CD	57.36
10-user comp upg CD	232.51

ModemShare V7.0

1 shared port, unlimited users	87.91
4 shared ports, unlimited users	291.24
32 shared ports, unlimited users	1569.24

COMPAQ

Netelligent 10BT PCI controller	103.50
Netelligent 10/100BTX PCI controller	139.05
Netelligent 2000 8-port 10BT repeater	484.30
Netelligent 2000 16-port 10BT repeater	619.70

intel.

EtherExpress 16 10BT	103.19
EtherExpress 16 10BT 5-pack	458.76
EtherExpress 16 combo	123.25
EtherExpress 16 combo 5-pack	542.71
EtherExpress PRO/10+Mbps ISA	98.23
EtherExpress PRO/100Mbps PCI	139.01
EtherExpress PRO/100Mbps EISA	246.25
EtherExpress PRO/100Mbps PCI 5-pack	619.36
NetportExpress EL Ethernet	373.30
TokenExpress PRO ISA LAN adapter	242.73

LINKSYS

Combo Ether16 LAN card	36.66
Combo EtherPCI LAN card	79.02
Combo PC/Ethernet card 10BT	105.88
PC Card LANmodem 10BT	339.85

SMC

EtherEZ coax ISA	91.63
EtherEZ 10BT ISA	92.03
EtherEZ combo	104.81
EtherPower 10BT PCI	117.39
EtherPower 10/100BT PCI	143.61
EtherPower coax PCI	148.63

DATA STORAGE

COLORADO MEMORY SYSTEMS, INC.

Jumbo 350 350MB TBU internal	59.70
Jumbo 1400 1.3GB TBU internal	226.67
Trakker 350MB TBU parallel	159.12
T1000E 800MB TBU parallel	189.68

iomega

Zip drive 100MB parallel	199.00
Zip drive 100MB SCSI	199.00
Ditto Easy 800MB Travan internal	119.00
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Jaz drive 1GB internal SCSI-2	399.00
Jaz drive 1GB external SCSI-2	499.00
Jaz drive 1GB cartridge	124.00

PINNACLE MICRO

10XTREME 10X CDR internal	232.71
RCD Explorer 2X CDR recorder internal	751.81
RCD 5040 2X CDR recorder internal	841.20
RCD 5040 2X CDR recorder external	942.75
Vertex 2.6GB optical hard drive internal	1311.61
Vertex 2.6GB optical hard drive external	1314.07

SyQuest

EZ135 135MB IDE internal	119.23
EZ135 135MB SCSI external	119.23
EZ135 135MB external	119.23
EZ135 135MB cartridge	19.45
EZFlyer 230MB SCSI external	291.47
EZFlyer 230MB external	291.47
EZFlyer 230MB cartridge	29.47

OVERDRIVE PROCESSORS

intel

Intel OverDrive DX4/75	142.12
Intel OverDrive DX4/100	178.74
Intel OverDrive Pentium 63MHz	138.66
Intel OverDrive Pentium 83MHz	189.27
Intel OverDrive Pentium 120/133MHz upg for 5/90, 5/66	253.45
Intel OverDrive Pentium 125MHz upg for 5/75	259.24
Intel OverDrive Pentium 150MHz upg for 5/90	319.20
Intel OverDrive Pentium 166MHz upg for 5/100	456.23

INPUT DEVICES

EPSON

PhotoPC digital camera	499.00
ActionScanning System II	403.27
ES1000C color scanner	539.86
ES1200C Pro color scanner	1134.01

HEWLETT PACKARD

HP ScanJet 4P flatbed scanner	468.08
HP ScanJet 4C flatbed scanner	894.09
HP ScanJet 4C document feeder	453.97

KODAK

DC20 Digital Science Camera	329.00
DC40 Digital Science Camera	599.00
DC50 Digital Science Camera	999.00

Logitech

MouseMan 96	49.17
Cordless MouseMan	67.44
TrackMan Marble	76.98
TrackMan Live! cordless pointer	109.40
PageScan color scanner	297.92

UMAX Computer Corporation

Vista-S6E SOHO scanner	368.06
Vista-S12 scanner	799.86

VISIONEER

PaperPort Vx scanner	257.45
PaperPort ix scanner	297.24

MONITORS

Mag Innovision DX1595 PnP 15" .28mm	359.58
Mag Innovision DX1795 PnP 17" .28mm	612.61
Mag Innovision DX15T 15" .26mm	394.49
Mag Innovision DX17T 17" .26mm	715.47
Mag Innovision MXP17F 17" .26mm	713.22
Mag Innovision MX21F 21" .28mm	1484.25
Magnavox CM2099 14" .28mm	252.29
Magnavox CM2015 15" .28mm	329.19
Magnavox CM1215 15" .28mm	342.50
Magnavox CM4018 17" .28mm	599.50
Magnavox 20CM64 20" .31mm	924.01
NEC C400 14" .28mm	308.75
NEC XV15+ 15" .28mm	473.13
NEC M500 15" .25mm	526.24
NEC XV17+ 17" .28mm	799.84
NEC XE21 21" .28mm	1679.48
NEC XP21 21" .28mm	1943.57
Samsung 17GLi 17" .28mm	759.00
Samsung 17GLsi 17" .26mm	919.00
Sony Multiscan 15sx 15" PnP .25mm	395.63
Sony Multiscan 15sfii 15" PnP .25mm	473.90
Sony Multiscan 17sfii 17" PnP .25mm	775.83
Sony Multiscan 17seii 17" PnP .25mm	976.41
Sony Multiscan 20sfii 20" PnP .30mm	1635.53
ViewSonic 15GS 15" .27mm	387.72
ViewSonic 17GS 17" .27mm	616.79
ViewSonic G810 21" .25mm	1494.55
ViewSonic P810 21" .25mm	1664.28
ViewSonic P815 21" .25mm	1863.54
ViewSonic PT810 21" .30mm	1591.52

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CREATIVE

Sound Blaster 16/3D Value PnP	94.63
Blaster CD 8X internal	139.45
Sound Blaster 32 PnP	154.30
Sound Blaster AWE32 PnP	222.45
Sound Blaster Discovery CD 8X	256.72
Sound Blaster Performance 8X	319.87
ADS TV Superscan 2 PC to TV converter	292.29
Connectix QuickCam for Windows	96.05
Connectix Color QuickCam for Windows	209.44
EXP CDS-621 portable 6X CD-ROM kit	371.28
EXP 8X CD w/game port PCMCIA	753.30
EXP 8X CD w/sound module PCMCIA	859.51
Microsolutions 4X CD parallel	219.67
Microsolutions 6X CD parallel	269.73
Microsolutions 6X CD w/sound parallel	359.58
Microsolutions 8X CD parallel	337.55
Minolta Snappy video still capture	181.98
NEC 4x4 4X CD 4-disc changer internal	99.00
NEC 4Xc 4X CD 7-disc changer external	342.15
NEC 6Xi 6X CD internal	243.82
NEC 6Xe 6X CD external	335.65
NEC 6V 8X CD internal IDE	153.71
NEC 8Xi 8X CD internal SCSI-2	341.76
NEC 8Xe 8X CD external SCSI-2	449.51
Panasonic portable 4X CD SCSI	399.00
Sony portable 4X CD Discman®	347.46
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410CS 5/90 8MB 772MB 11.3" dual	2578.81
410CDT 5/90 8MB 772MB 11.3" active 4X CD	3249.60
420CDS 5/100 8MB 810MB 11.3" dual 6X CD	2489.30
420CDT 5/100 8MB 1.26GB 11.3" active 6X CD	3398.25

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500CS 5/120 16MB 1.26GB 12.1" dual	3657.56
500CDT 5/120 16MB 1.26GB 12.1" active 6X CD	4519.30
610CT 5/90 8MB 720MB 9.5" active	2429.66
650CT 5/133 16MB 1.26GB 11.3" active	4339.19

Tecra Notebooks

700CS 5/120 8MB 1.2GB 11.3" dual	3899.52
720CDT 5/133 16MB 1.2GB 12.1" active 6X CD	5289.11
730CDT 5/150 16MB 2GB 12.1" active 6X CD	5896.51

AST

Ascentia Notebooks

J10 5/75 8MB 500MB 10.4" dual	1979.47
J20 5/100 8MB 540MB 11.3" dual	1736.97
J30 5/100 8MB 800MB 10.4" dual	2326.86
J30 5/100 8MB 800MB 10.4" active	2808.50
J50 5/133 8MB 800MB 10.4" active	3275.85
P30 5/100 8MB 800MB 11.3" dual 4X CD	2989.46
P30 5/100 8MB 1.2GB 11.3" dual 4X CD	3351.37
P40 5/120 16MB 1GB 11.3" active 6X CD	3287.93
P40 5/120 16MB 2.1GB 11.3" active 6X CD	3749.59
P50 5/133 8MB 800MB 11.3" active 4X CD	3921.72
P50 5/133 8MB 1.2GB 11.3" active 4X CD	4346.19
P50 5/133 24MB 2.1GB 12.1" active 6X CD	4217.73
P50 5/133 24MB 2.1GB 12.1" active 6X CD	4676.95

Advantage! Lifestyle Mini-towers

9312 5/166 16MB 2.5GB 8X CD	2445.84
9310 5/166 24MB 2.5GB 8X CD	2351.94
9315 5/166 32MB 2.5GB 8X CD	2633.64
9316 5/200 32MB 3GB 8X CD	2821.44

Advantage! 9300 Series Mini-towers

9304 5/133 24MB 1.6GB 8X CD	1659.53
9308 5/166 24MB 2.5GB 8X CD	2073.30
9314 5/200 24MB 4GB 8X CD	2633.64

Bravo Desktops

LC 5100 5/100 8MB 630MB	1167.46
LC 5100 5/100 16MB 1.2GB	1419.58
LC 5133 5/133 8MB 630MB	1293.52
LC 5133 5/133 16MB 1.2GB	1512.76
LC 5166 5/166 16MB 1.2GB	1883.27
MS 5100 5/100 16MB 1.2GB	1665.06
MS 5100 5/100 16MB 2.1GB	1775.79
MS 5133 5/133 16MB 1.2GB	1775.79
MS 5133 5/133 16MB 2.1GB	1886.53
MS 5166 5/166 16MB 2.1GB	2384.91

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MS-T 5100 5/100 16MB 1.2GB	1719.38
MS-T 5100 5/100 16MB 2.1GB	1831.01
MS-T 5133 5/133 16MB 1.2GB	1831.01
MS-T 5133 5/133 16MB 2.1GB	1991.29

IBM

ThinkPad Notebooks

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365X 5/100 8MB 810MB 10.4" active	2339.05
365XD 5/100 8MB 810MB 10.4" dual 4X CD	2239.15
365XD 5/120 8MB 1GB 11.3" dual 4X CD	2486.30
365XD 5/120 8MB 1GB 10.4" active 4X CD	2947.15
560 5/100 8MB 810MB 11.3" dual	2678.94
560 5/120 8MB 810MB 12.1" active	3743.78
560 5/133 8MB 1GB 12.1" active	4195.15
760E 5/120 8MB 810MB 12.1" active	4367.54
760E 5/120 8MB 1.2GB 12.1" active	4427.71
760E 5/133 16MB 1.08GB 12.1" active	5047.85
760ED 5/133 16MB 1.2GB 12.1" active 4X CD	6094.56
760EL 5/100 8MB 810MB 11.3" dual	3258.44
760ELD 5/100 8MB 810MB 12.1" active 4X CD	4499.78
760EL 5/120 8MB 810MB 11.3" dual	3409.81
760EL 5/120 8MB 1.08GB 12.1" active	4399.14
760EL 5/133 16MB 1.08GB 12.1" active	5497.32

Aptiva Series Desktops

C33 5/133 16MB 1.6GB 8X CD	1999.00
C65 5/166 16MB 2GB 8X CD	2449.00
C73 5/200 16MB 2.5GB 8X CD	2899.00

PC300 Series Desktops

PC330 5/133 16MB 1.2GB 3 bays	1739.91
PC330 5/133 16MB 1.6GB 3bays	1808.89
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PC340 5/133 16MB 1.2GB 4 bays	1597.85
PC350 5/100 16MB 1.2GB 5 bays	1549.15
PC350 5/133 16MB 1.2GB 5 bays	1775.79
PC350 5/133 16MB 1.6GB 5 bays	1839.39
PC350 5/133 16MB 1.6GB 5 bays 6X CD	1996.82
PC350 5/166 16MB 1.6GB 5 bays	2146.32

PC700 Series Desktops

PC700 5/100 16MB 1.2GB 5 bays	1893.94
PC700 5/133 16MB 1.2GB 5 bays	2079.62
PC700 5/166 16MB 1.2GB 5 bays	2542.16

COMPUTERS

COMPAQ

Armada Notebooks

1120 5/100 8MB 810MB 10.4" dual	1838.23
1120T 5/100 8MB 810MB 10.4" active	2208.02
4110 5/100 8MB 810MB 11.3" dual	2496.17
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4130T 5/133 16MB 1.08GB 11.8" active	4417.17

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5000 5/75 8MB 810MB 10.4" active	3648.77
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Deskpro 2000 Series Desktops

5100/630 5/100 8MB 630MB	1118.70
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5133/2500 5/133 16MB 2.5GB	1858.85
5166/1200 5/166 16MB 1.2GB	1966.20
5166/2500 5/166 16MB 2.5GB	2169.60
5200/2500 5/200 32MB 2.5GB	2768.50
6180/1200/CD 6/180 16MB 1.2GB 8X CD	2542.50
6200/2500/CD 6/200 16MB 2.5GB 8X CD	3152.70

Deskpro 2000 Series Mini-towers

5133/2500/CD 5/133 16MB 2.5GB 8X CD	2073.55
5166/2500/CD 5/166 32MB 2.5GB 8X CD	2621.60
6200/2500/CD 6/200 32MB 2.5GB 8X CD	3406.95

Deskpro 4000 Series Desktops

5120/1080 5/120 16MB 1.08GB	1627.20
5120/1620/LS 5/120 16MB 1.62GB	1875.80
5133/1080 5/133 16MB 1.08GB	1808.00
5133/1620 5/133 16MB 1.62GB	1875.80
5166/1620 5/166 16MB 1.62GB	2186.55
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6180/1620/CDS 6/180 32MB 1.62GB	3051.00
6200/2500/LS/CDS 6/200 32MB 2.5GB	3638.60

Deskpro 4000 Series Mini-towers

5133/1620/LS 5/133 32MB 1.62GB	2309.85
5166/2500/CDS 5/166 32MB 2.5GB	2881.50

Deskpro 6000 Series Desktops

5166/1080/CDS 5/166 16MB 1.08GB 8X CD	2847.60
5166/1080/CDS 5/166 32MB 1.08GB 8X CD	3107.50
5200/1080/CDS 5/200 32MB 1.08GB 8X CD	3519.95
6180/2150/CDS 6/180 32MB 2.15GB 8X CD	3813.75
6200/2150/CDS 6/200 32MB 2.15GB 8X CD	3983.25
6200/4200/PDS 6/200 32MB 4.2GB PD-CD	4847.70

Deskpro 6000 Series Mini-towers

5166/2150/CDS 5/166 32MB 2.15GB 8X CD	3519.95
6200/4200/PDS 6/200 32MB 4.2GB PD-CD	4881.60

NEC

Versa Notebooks

2400 5/100 8MB 810MB 11.3" dual	2299.00
2400CD 5/100 16MB 1GB 11.3" dual 6X CD	2699.00
4200 5/100 8MB 810MB 10.4" active	2999.00
4230 5/133 8MB 1GB 10.4" active 6X CD	3899.00
4050H 5/90 8MB 810MB 10.4" active	2999.00
4080H 5/120 8MB 1GB 10.4" active	3699.00
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570CDT 5/100 8MB 1.2GB 10.4" active 4X CD	2894.07

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TM5300 5/133 8MB 1.2GB 11.3" active	3279.37
TM6020 5/120 8MB 1.08GB 11.3" active	4041.95
TM6030 5/133 16MB 1.35GB 12.1" active	4805.26

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Vectra 500 Series Desktops

510CD 5/120 16MB 1.28GB 6X CD	1619.17

Vectra 500 Series Mini-towers

515CCx 5/120 16MB 1.28GB 6X CD	1819.73
515CD 5/133 16MB 1.62GB 6X CD	1828.93
515MCx 5/133 16MB 1.62GB 6X CD	2059.95
515MCx 5/150 16MB 1.62GB 6X CD	2169.25
515MCx 5/166 16MB 1.62GB 6X CD	2349.03

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Canon

BJ30 monochrome	265.50	MultiPASS 800	
BJC70	293.86	print/copy/scan/fax	499.00
BJC210	149.00	MultiPASS C2500 color	
BJC610	429.00	print/copy/scan/fax	599.00
BJC4100	229.00		

EPSON

AP5000+	216.01	LX300	167.09
DFX5000+	1385.48	Stylus 1500	995.00
DFX8000	2333.18	Stylus Color 500	279.00
FX870	289.45	Stylus Color II	279.00
FX1170	376.56	Stylus Color IIs	169.73
LQ870	443.03	Stylus Pro color	379.00
LQ1070+	389.60	Stylus Pro XL color	1799.00
LQ2170	599.00		

HEWLETT-PACKARD

HP DeskJet 340 portable inkjet printer	293.84
HP DeskJet 682C color printer	299.00
HP DeskJet 820Cse color printer	399.00
HP DeskJet 855Cse color printer	412.31
HP LaserJet 5P printer	881.83
HP OfficeJet inkjet fax/copier/printer	494.03
HP OfficeJet 350 inkjet fax/copier/printer/scanner	599.00

LEXMARK

4039 10 Plus	1064.43	Optra N	2686.10
Optra E	555.52	Optra R+	1253.62
Optra LX+	1849.39	Optra Rt+	1481.54

OKIDATA

184 Turbo	228.28
320 Turbo	317.06
321 Turbo	445.72
ML395	1005.83
ML520	581.94
ML521	509.02
ML590	445.72
ML591	603.67
Okipage 4w	299.00
OL600e	399.00
OL610e/PS	693.66
OL810E	755.42

TEXAS INSTRUMENTS

microLaser 600	695.69
microLaser Pro/8	1103.88
microLaser PowerPro/12	1359.39

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Seagate

631MB Fast-ATA	165.94
1.08GB Fast-ATA2	206.84
1.08GB Fast SCSI-2	269.73
2.1GB Fast ATA-2	302.98
2.14GB Fast SCSI-2	736.68
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4.29GB Fast SCSI-2	956.12
9GB Fast SCSI-2	1965.49

WESTERN DIGITAL

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Caviar 1.2GB EIDE	225.37
Caviar 1.62GB EIDE	236.16
Caviar 2.1GB EIDE-2	311.06
Caviar 2.5GB EIDE-2	368.30

CONTROLLERS

Acculogic SIDE-4+ w/par 2 serial game	29.16
Acculogic SIDE-3+ w/on-board BIOS	37.18
Adaptec AVA1505 SCSI-2 CD Kit	48.07
Adaptec 1542CP SCSI Master Kit	255.34
Adaptec PCI Ultra Wide SCSI Kit	266.08
Promise EIDEMAX ISA 2HD on-brd BIOS	25.81
Promise EIDE2300+ VLB 4HD on-brd BIOS	6550.49.47

MODEMS & COMMUNICATIONS

Hayes

ACCURA 144 internal w/fax	79.05
ACCURA 144 external w/fax	92.23
ACCURA 288 V.34 internal w/fax	141.13
ACCURA 288 V.34 external w/fax	159.94
ACCURA 288 DSVD internal	236.48
ACCURA 288 DSVD external	252.32
OPTIMA 288 Business Modem external	217.94
OPTIMA 288 V.34 internal w/fax	225.38

MODEMS & COMMUNICATIONS

MOTOROLA

BitSURFR ISDN adapter internal	263.97
BitSURFR ISDN adapter external	263.63
BitSURFR Pro ISDN terminal adapter	345.90
ModemSURFR V.34 28.8 internal	111.39
ModemSURFR V.34 28.8 internal	111.39
ModemSURFR V.34 28.8 external	117.60
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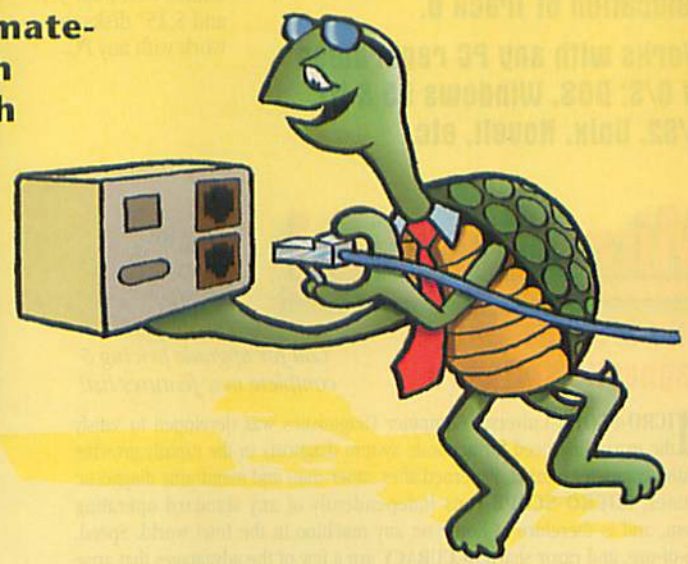

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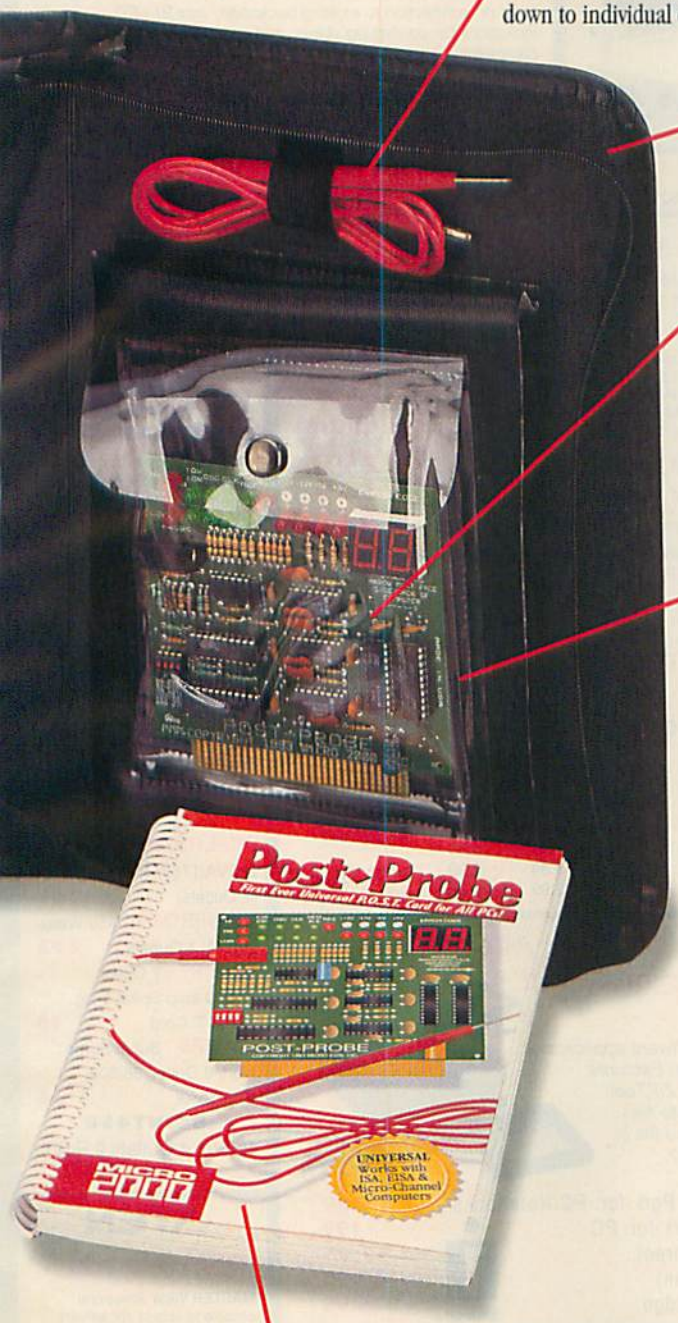

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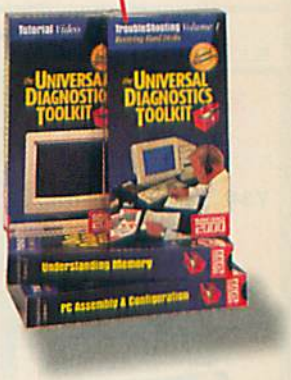

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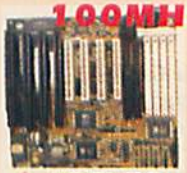

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3.3V SDRAM	*16Meg*	*249.00*
3.3V SDRAM	*32 Meg*	*489.00*

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16Meg	169.00
32Meg	329.00
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32Meg	479.00
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72 Pin, 3.3V	16Meg	239.00
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72 Pin, 5V	8Meg	129.00
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144 Pin, 5V EDO	8Meg	159.00
144 Pin, 5V EDO	16Meg	299.00
144 Pin, 5V EDO	32Meg	599.00
144 Pin, 5V EDO	64Meg	3029.00

AST MEMORY

MODEL	AMT. UPGRADED	AST PART #	PRICE
Bravo LC Series, Bravo MT, Bravo MS,	4Meg	500987-002	39.00
MS-L, Advantage Pro DX33, SX25	8Meg	500987-003	79.00
	16Meg	500987-004	139.00
	32Meg	500987-005	279.00
Premmia LX P/60, MX4/66d, 4/100T, P/80	8 Meg	500987-005	79.00
	16 Meg	511347-001	180.00
	32 Meg	500987-006	279.00
	64 Meg	511569-001	649.00
Premmia 4133, 4133S, 4/50d, 4/60d	8 Meg	511119-002	99.00
Premmia SE 4/33, 4/66d, P/60	16 Meg	511119-003	149.00
Premmia MTE 4/33, 4/66d, P/60	32 Meg	511119-004	329.00
Manhattan G, V Series Server	64 Meg	511119-005	699.00
Power Premium 3/33, 4/33, 4/50d, 4/66d	8Meg	500780-001	168.00
Premium 486/25, 486/25E, 486/33, 486/33E			
Premium 386/33TE, 486/33TE, 486/33TE			
Prem. II 386/25, 386/33, 486/33, 486 SX/20			
Bravo 486/25, 486/33	2 Meg Kit	500780-005	68.00
Advantage 486/25, 486/33, 486/33P, 486 SX/20			
Premium SE4/33	8Meg Kit	500780-001	168.00
Premium SE 4/50, d, 66d, P/60	1 Meg	500780-003	19.00
Prem. 386/33, 386 SX16, Prem. II 386SX 20, 386/25	4Meg	500780-004	84.00
Premmia GX P/60, P/100	8Meg Kit/16MegKit	501565-001/501566-001	99/178
	32Meg Kit/64MegKit	501567-001/501568-001	319/669
AST Cupid Board	0-32 Meg	500818-001	159.00

AMBRA

Ambra NC 425SL	2/4/8 Meg	69/109/189
Ambra N Series	*4/8/12/16 Meg*	*99/169/269/339*
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Ambra N-75, N-100	4/8/16	99/129/219

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64H5604/9307196 (2Meg)	70-061, E61, 121, 502, 555X, 65SX, P-70,	39.00
	55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40EX	
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 325T	29.00
34F3633 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	59.00
87H9977/9307199 (4Meg)	35SX, 55LS, 65SX, 40EX, 35SX, 35LS	59.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2/21	69.00
92F9684 (4Meg)	P/S1 & P/S1/386SX, Model 2/21	69.00
92G7200 (4Meg)	PSI Expert, Consultant, Willow	69.00
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4Meg/8Meg/16Meg/32Meg	*PC Power Series*	*39/69/134/299*
4Meg/8Meg/16Meg/32Meg	*PC Server 300, 325, 520*	*39/69/134/299*
8Meg/16Meg/32Meg (Ecc)	*PC Server 500*	*179/239/479*
92G7234 (16Meg 168 pin Edo)	*IBM 720/750*	*169.00*
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92G7539 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730, Pentium	39.00
92G7541 (8Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730, Pentium	69.00
92G7543 (16Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730, Pentium	129.00
92G7545 (32Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730, Pentium	299.00
73G3131/92G7201 (4Meg)	Value Point Performance, PC Server 4/66	49.00
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6450902 (2Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC	49.00
	Value Point 77 486SX2, 486SX, SVR 85	
6450128/9207200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX,	49.00
	Mod-2123, 2133, 2155, Val Pt 77, 486CS2, 486SX, SVR85	
	Value Point 77 486DX2, 486SX, SVR 85	
6450129/9207428 (8Meg)	85SX, 40SX	99.00
6450130/9207202 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC	99.00
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66G0094 (4Meg)	Thinkpad 755, 365, 360, 355, 340, 450	49.00
66G0094 (8Meg)	Thinkpad 755, 365, 360, 355, 340, 450	139.00
66G0094 (16Meg, 32Meg)	*Thinkpad 755, 360, 355, 340, 450*	*229/599*
8Meg/16Meg/32Meg	*Thinkpad 760EX, E6, E5, 365X, XD*	*119/249/1279*
81B9098 (4Meg)	Thinkpad 500, 510CS (3.3 volt)	89.00
81B9099 (8Meg, 16Meg)	Thinkpad 500, 510CS (3.3 volt)	139/339
79F0999 (2Meg)	L440, N33SX, PS Note	69.00
79F1000 (4Meg)	L440, N33SX, PS Note, Tkpd 350, 350c, PS Note 425	99.00
79F1001 (8Meg)	L440, N33SX, PS Note	159.00
(4Meg/16Meg)	Thinkpad 755 Omni Modules	95/219
(4Meg/16 Meg w/Adap	Thinkpad 755	174/389
60G0078 (8Meg)	Thinkpad 350, 350c, PS Note 425	119.00
60G0079 (16Meg)	Thinkpad 350, 350c, PS Note 425	199.00
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92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	69.00
92G7261 (8Meg)	Thinkpad 701C, CS, Butterfly	129.00
92G7263 (16Meg, 32Meg)	Thinkpad 701C, CS, Butterfly	199/536
8Meg/16Meg	Thinkpad 820	219/399
4Meg/8Meg/16Meg/32Meg	Thinkpad 850	99/169/299/499
8Meg/16Meg/32Meg	*Thinkpad 700*	*129/199/Call*

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Deskpro System Pro 386/33, 486/25, 486/50L	2/8/32Meg	29/89/299
Deskpro 4/66i, 4/33i, 4/25i/S, 3733i, 3/25i	2/4/8Meg	59/89/169
Deskpro "M" Series	Expansion Board DK	119
Deskpro 450, 466, 4100, 575, 590, 5120, 5133	4/8/16/32Meg	49/99/179/339
Deskpro XE 433S, 450, 466	2/4/8Meg	49/99/179
Deskpro XE 560 (pairs)	4/8/16/32/64Meg	39/69/139/299/599
Deskpro XL450, 466, XL560, xl566, XL575, 5100 xl590	4/8/16/32/64Meg	39/69/139/299/799
Presario 433, CD6535, CDJV620, CDLS34, CD5626, CDTV528	4/8/16/32Meg	39/69/139/299
660, CD5660, CD5720, CD5724, CDS744, CD5860		
CD5820, CDTV920, 924, CD5924, CD5954		
Presario 400 Series, 600 Series, 800 Series	4/8/16/32Meg	39/69/139/299
Presario CD5774, CD5972, CD5982, CDTV978, CD5974 (in pairs)	4/8/16/32Meg	39/69/139/299
CD5992, 7152, 7170, 7180, 9546, 9548, 9564		
Prolines 4/25S, 4/33, 4/33S, 4/50, 466, CDS	1/2/4/8Meg	19/29/49/99
Prolines MT 433S, 450, 466, Innovance 433S, 450S, 450, 466	4/8/16/32 Meg	39/69/139/299
Prolines 450, 466, 4100, 575, 590, 5120, 575, 590, 5120	4/8/16/32Meg	39/69/139/299
575 mini, 5100 mini, 5133 mini		
Proliant 1500 5/75, 5/100, 1500R 5/75, 5/100 (install in pairs)	4/8/16/32Meg	39/69/139/299
Prosignia 300, 575, 590, 500 5/90, 500 5/120 (install in pairs)	4/8/16/32Meg	39/69/139/299
Proliant 1000 5/60, Prosignia 5/60 (install in pairs)	4/8/16/32	39/69/139/299
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LTE/386S/20	4Meg Module	121125-002	95.00
LTE LITE/20, 25, 25C	8Meg Module	129769-002	99.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	149.00
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LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	49.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	89.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	279.00
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Contura 320, 325	8Meg	139498-001	99.00
	8Meg	139499-001	139.00
Contura 420, 410, 420, 430	4Meg/8Meg/16Meg		49/119/219
Contura 4/25, 4/25C, 4/25CX	4Meg	146535-001	79.00
	8Meg	146521-001	119.00
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Tecra 700, 710, 720 (SDRAM)	*8Meg/16Meg/32Meg*		*149/299/599*
Tecra 700, 710, 720	*8/16Meg/1.3Gig*		*729/819*
T2000SX/U/2000SX/T1800, 1850, C	2Meg/4Meg/8Meg	PC-PA2000U	69/99/179
T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		79/119/219/349
74500, C, 74600, 74700, T1900, C, T1910, T1950 (3.3 v)	4Meg/32Meg	PC-PA2012U	69.00
74500, C, 74600, 74700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	109.00
74500, C, 74600, 74700, T1900, C, T1910, T1950 (3.3 v)	16Meg/32Meg	PC-PA2014U	199/Call
T3400CT, T3400, T3600	4Meg/8Meg/16Meg	PC-PA2019U	99/139/279
T800, 805, CT Edo	8Meg/16Meg/32Meg		119/199/359
1400CS, 400CDT, T100, 105 Edo	*8Meg/16Meg/32Meg*		*119/199/359*

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
Aspire 720, 720C, 780, 780	2Meg/4Meg/8Meg		49/79/129
Aspire 780, 785, 782, 784, 786, 787,	4Meg/8Meg/16Meg		69/119/219
Aspire 1600	4Meg/8Meg/16Meg		69/119/219
ACER Note Pro, ACER Note Lite, 350, 355	*4Meg/8Meg*		*59/99*
ACER 386	*4Meg/8Meg*		*59/109*
AST Ascentia P30, P50	*4Meg/8Meg*		*99/189*
AST Ascentia 710, 720, 750	*8Meg/16Meg/32Meg/64Meg*		*119/219/429/Call*
AST Ascentia 800N, 810, 910	4Meg/8Meg		79/149
AST Ascentia 950	4Meg/8Meg		79/149
AST Bravo & Explorer	*4Meg/16Meg*	*501295-001, -002*	*79/219*
Notebook Prem Exec 386SX/20/25/SL		501146-001	79/149
AST Power Exec 3/25, 425EL, 425SL	4Meg/16Meg	501166-001, -003	89/219
AST Power Exec 4/25, 4/40	4Meg/16Meg	501318-001,002	89/219
AT&T Globalyst 130, 200, 250	4Meg/8Meg/16Meg		79/119/219
AT&T GIS 3451SX		PEC 37651	149.00
Austin DX2, SX2, SX Series	4Meg/8Meg/16Meg		79/119/219
Austin Vista	*4Meg/8Meg/16Meg*		*Call*
Canon Innova Book 150	4Meg/8Meg/16Meg		79/129
Canon Innova Book 300LS	4Meg/8Meg/16Meg		89/99/219
Canon Innova Book 350CD, 360, 475	*4Meg/8Meg*		*89/179*
Canon Notebook 486	4Meg/8Meg		79/149
Canon Notebook 486 SE	4Meg/8Meg		89/169
Canon Notebook 486SE, 25 and 33	4Meg/8Meg		89/169
Canon Notebook 486SE, 100	4Meg/8Meg		89/169
Compaq 4/25c, 4/25cx	4Meg/8Meg/16Meg		79/119/219
ZT1 32 Bus Solo Family Series	*4Meg/8Meg/16Meg*		*79/119/219*
DEC Hinote, Ultra Hinote	4Meg/8Meg/16Meg		79/219
DEC Hinote VP	*8Meg/16Meg/32Meg*		*119/219/399*
Dell Latitude LM	*4Meg/8Meg*		*79/119*
Dell Latitude LX 4100C, MX, MC, M	4Meg/8Meg/16Meg		79/119/219
Dell Latitude XP	4Meg/8Meg/16Meg		79/119/219
Dell Latitude XP, 475, 4100, 4100CX	4Meg/8Meg/16Meg		Call
Dell Latitude 466, 425, 433C, 433CX, 450, 450CX	4 Meg/16 Meg		Call
DTK, 386 SX 4T	4Meg/8Meg/16Meg		119/299
Epson Action Note 600, 650c, 660c, 660cx	4Meg/8Meg/16Meg		89/169
Epson Action Note 880, 880c	4Meg/8Meg/16Meg		89/169
Epson Action Note 880, 880, 888c	4Meg/8Meg/16Meg		79/119/219
Epson ActionNote 890	*4Meg/8Meg*		*79/119*
Epson ActionNote 4/25SX, Notebook	4Meg/8Meg		79/119
Epson ActionNote 4/C25S, 4SLC/2-50	4Meg/8Meg		119
Epson Equity LX, LX20, Carrier	4Meg/8Meg	PCA 00053-0001	119
Fujitsu Lifebook	*8Meg/16Meg/32Meg*		*219/299/599*
Fujitsu Lifebook Series	*4Meg/8Meg/32Meg*		*79/119/279*
Fujitsu Stylistic Carrier	*4Meg/8Meg/32Meg*		*119/229/419*
Gateway Handbook 4/33	4Meg/16Meg		79/219
gateway 1000 Nomad 425 CXL/SXL	4Meg/16Meg		79/219
gateway 1000 HMI Handbook or Liberty	4Meg/16Meg		79/219
gateway 2000 Solo Series	4Meg/8Meg/16Meg		89/129
HP Omnibook 425, 425	4Meg/8Meg		89
HP Omnibook 600, 600	4Meg/8Meg		89/169
HP Omnibook 600C	4Meg/8Meg		89/169
HP Omnibook 800	8Meg/16Meg		89/169
HP Omnibook 800C	8Meg/16Meg		89/169
Leading Edge Aviva 2000	4Meg		119
Leo/ISA	4Meg		119
Magnavox Metalis	4Meg/8Meg/16Meg	286, 386EX	79/119/219
Midwest Micro Elite SX-25, DX2-50, DX2-66	4Meg/8Meg/16Meg		79/119/219
Midwest Micro Elite SX-25, DX4-100	4Meg/8Meg/16Meg		79/119/219
Midwest Micro Elite Sx/da Plus 20-25, 25-50	4Meg/8Meg/16Meg		79/119/219
Mitsubishi Amity	4Meg/8Meg/16Meg		79/119/219
Mitsubishi Apricot	*4Meg/8Meg/16Meg*		*69/99/189*
MPC Model 386	4Meg/8Meg/16Meg		79/119
NEC Safari 310D, 311	4Meg/8Meg/16Meg		79/119
NEC Ultralite Versa, V, V MP	4 Meg/8Meg/16Meg	OP4104	64/109/219
NEC Versa E, Versa 2000S, & 2000D	4Meg/8Meg/16Meg		79/119/219
NEC Versa E, Versa 2000S,	4Meg/8Meg/16Meg		79/119/219
NEC Versa 6000	*8/16/32/64Meg*		*189/299/529/799*
Olivetti Quaderno, Quaderno SX, 286	4Meg/8Meg	286, 386SX	79/119
Panasonic Partner	2Meg/4Meg		65/99
Panasonic FS-1, FS-1A	4Meg		79/119
Panasonic FS-1, FS-1A, CF-580	4Meg/8Meg		79/119/219
Sager Models, all models	*4Meg/8Meg/16Meg*		*Call*
Sanyo 1740 NB	4Meg/8Meg/16Meg	MBC-NBMEM2	89
Sceptre Sounds, all models	*4Meg/8Meg*		*89/129/219*
Sharp PC 6000, 6020, 6040, 6060, 6741	2Meg/4Meg		69/99
Sharp 6100, 6200, 7100, 7150	4Meg/8Meg/16Meg		69/129
Sharp 6300, 7300	4Meg/8Meg/16Meg		69/129
Sharp 6500, 6550, 3060	4Meg/8Meg/16Meg		69/129
Sharp 6600	4Meg/8Meg/16Meg		69/129
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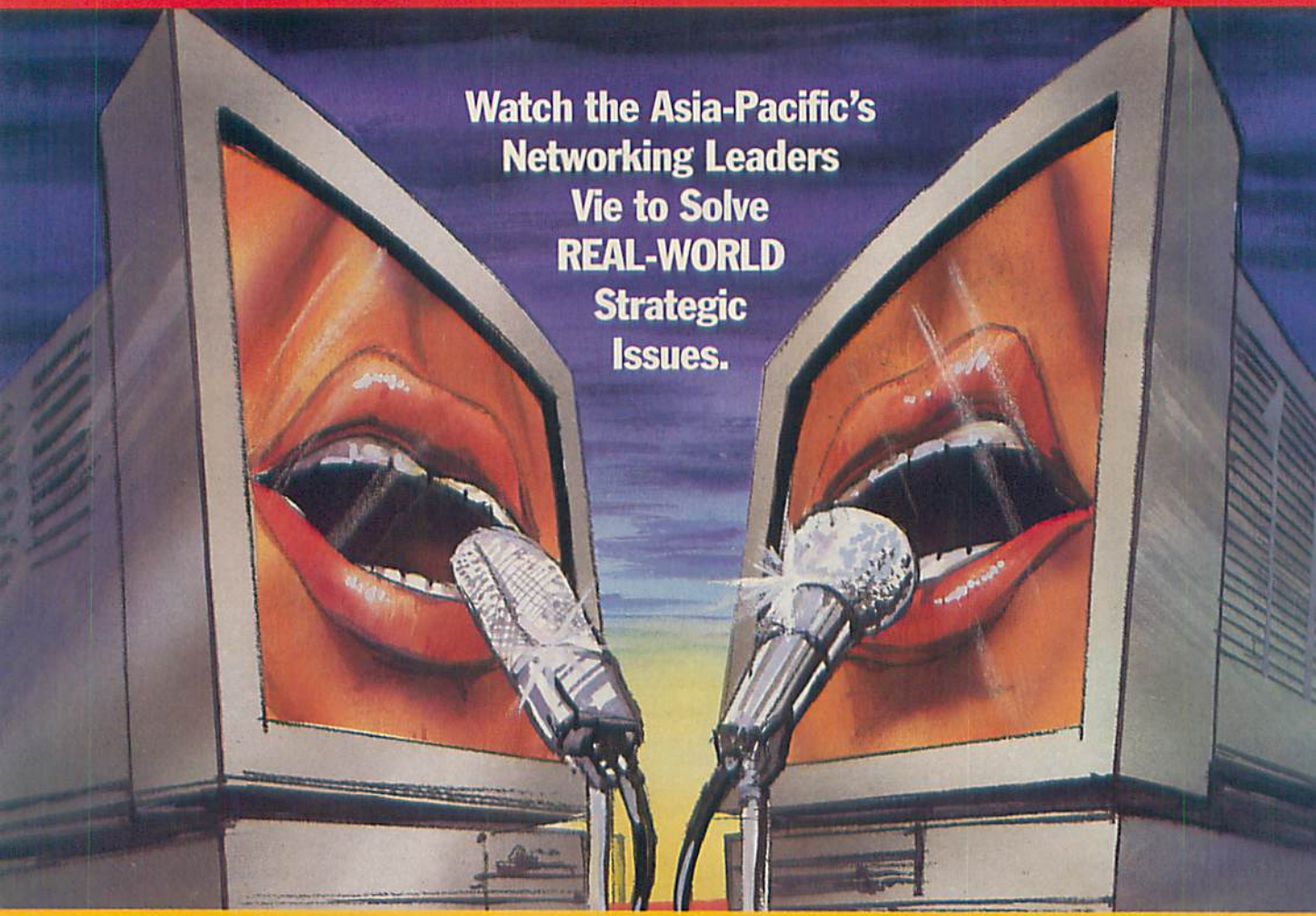

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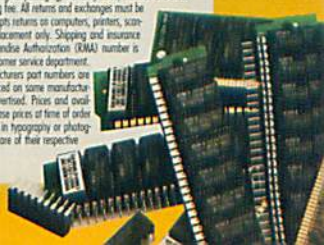

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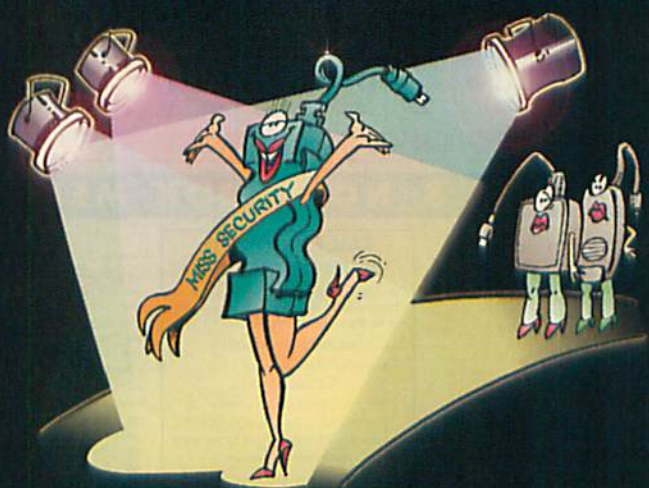

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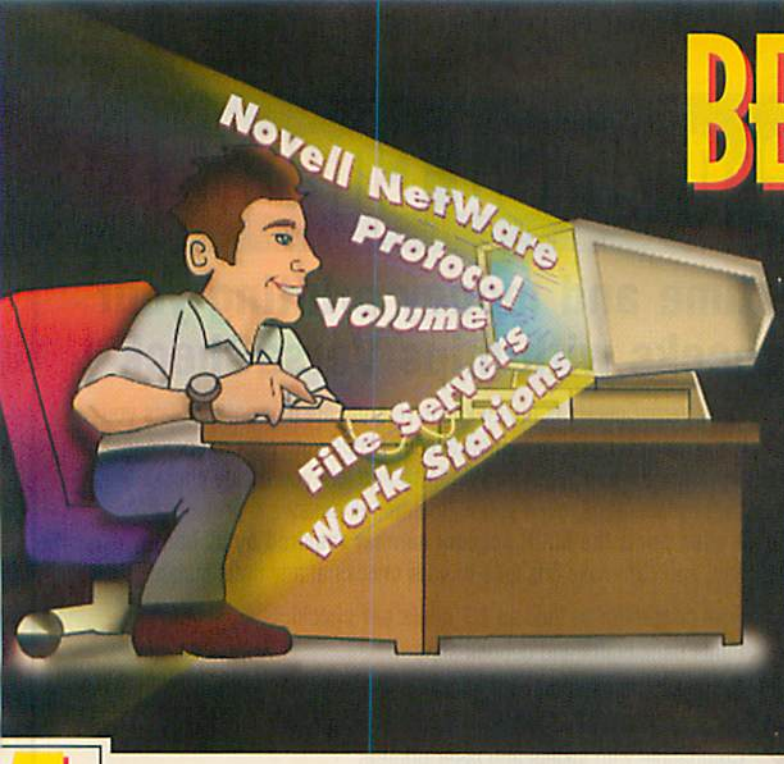

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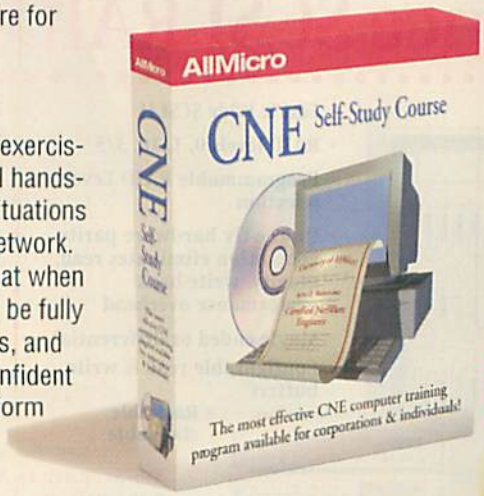

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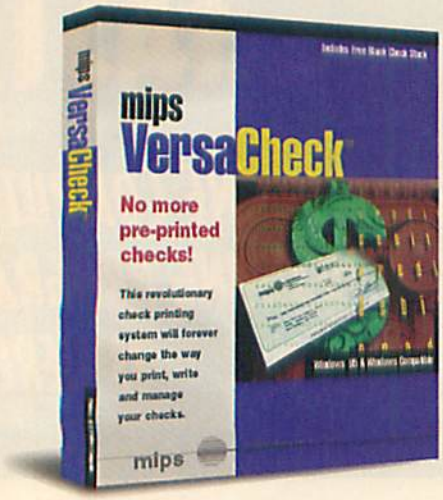

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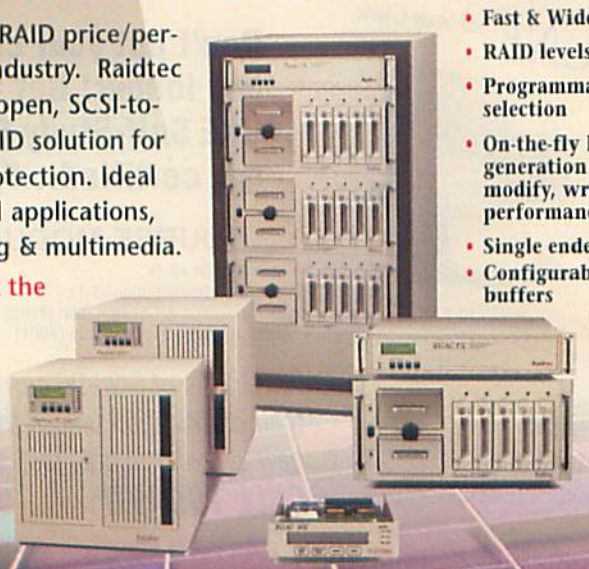

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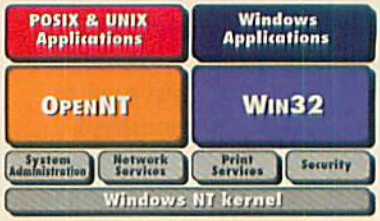

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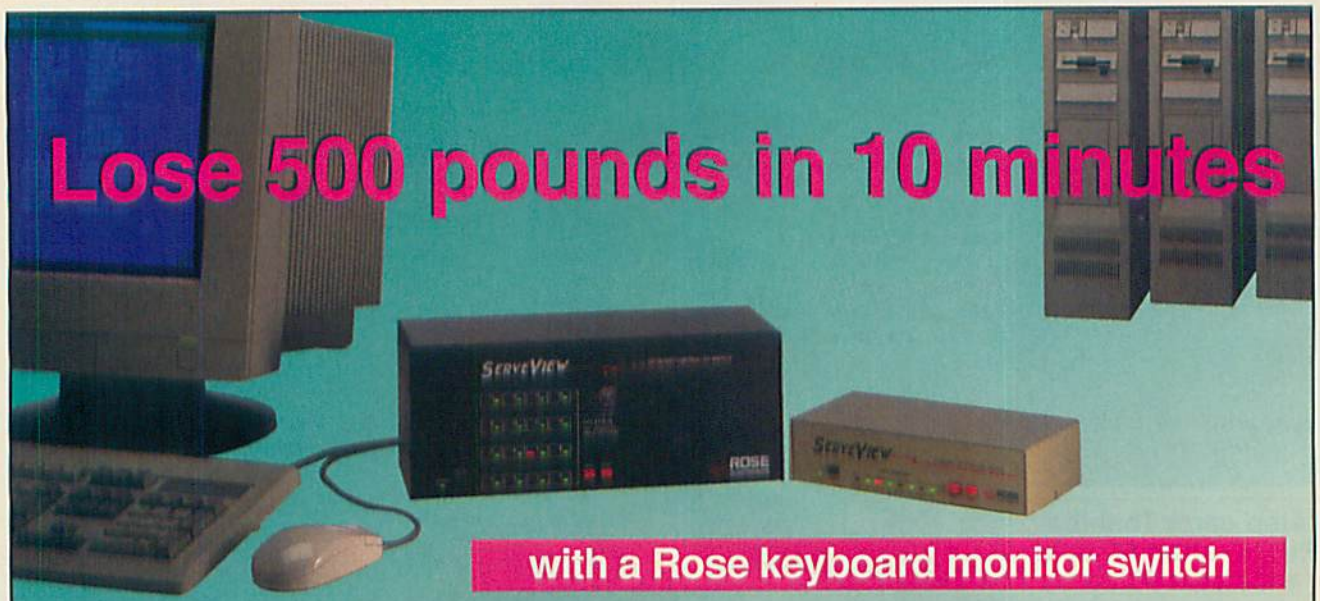

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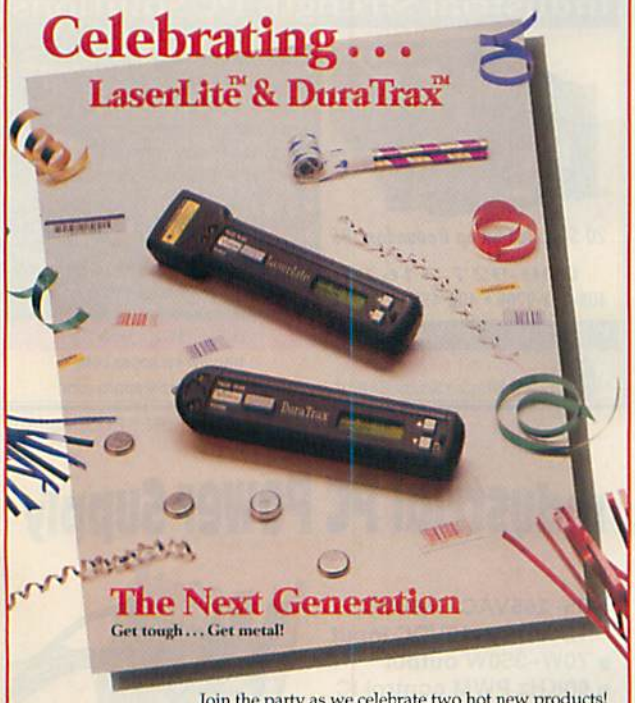

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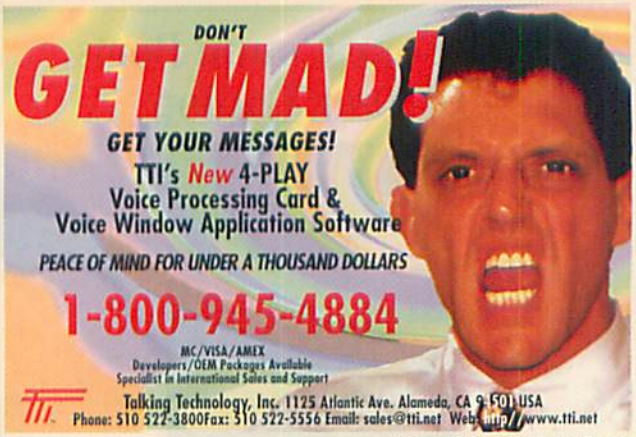

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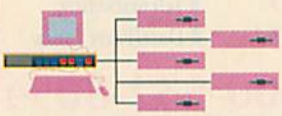

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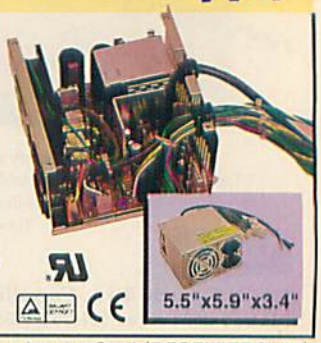

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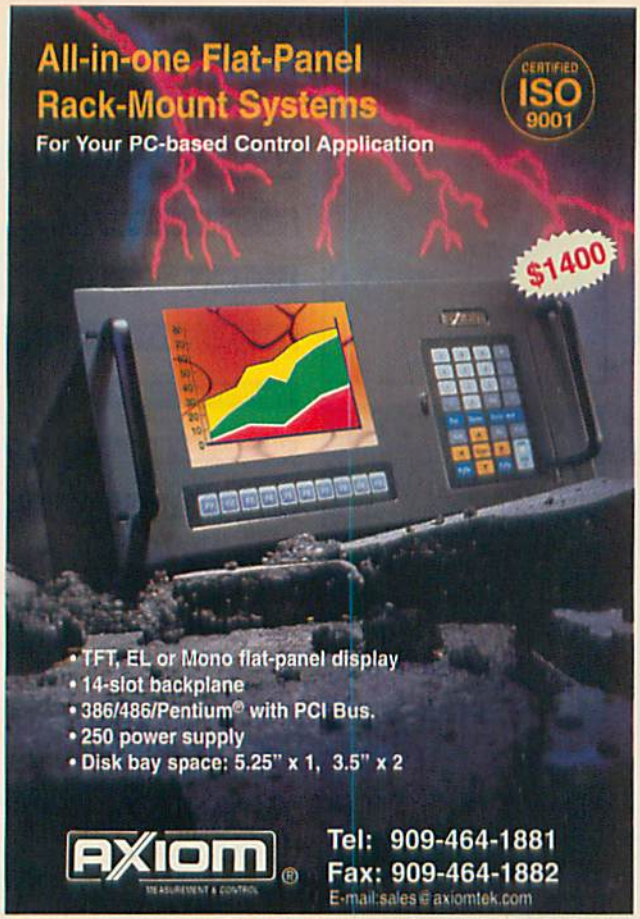
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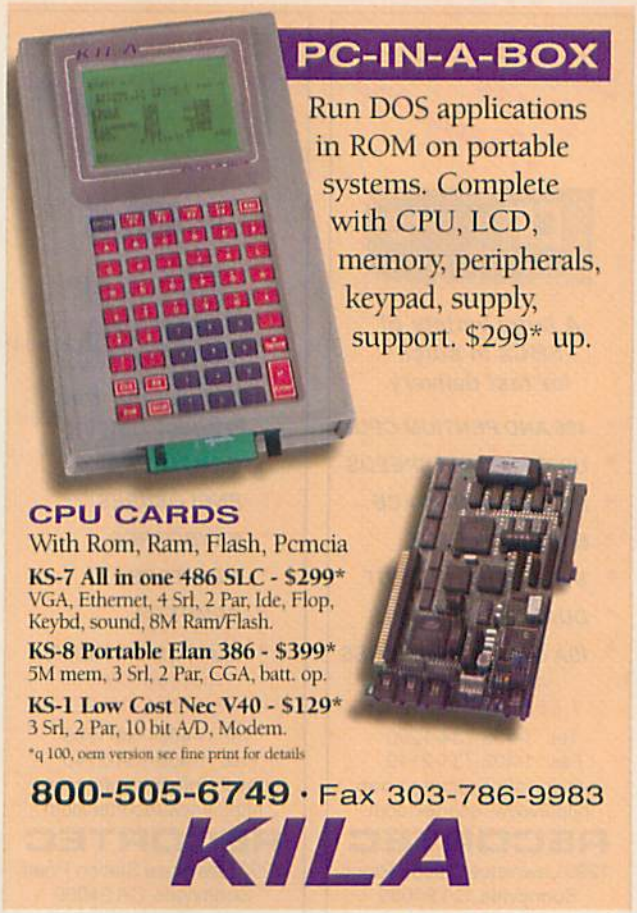
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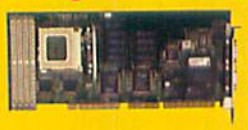

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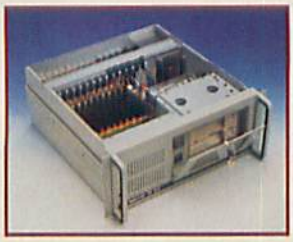

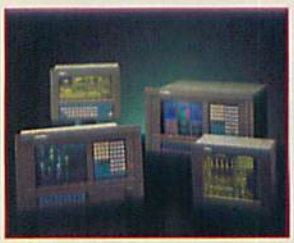

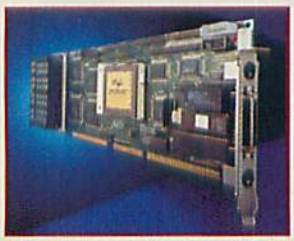

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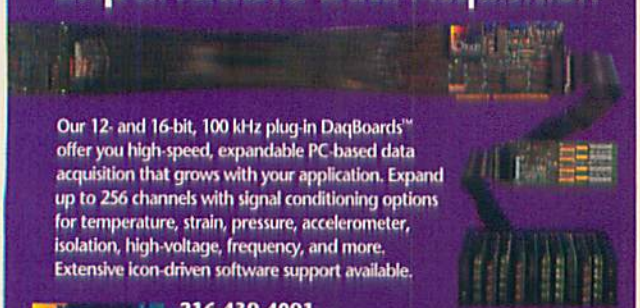

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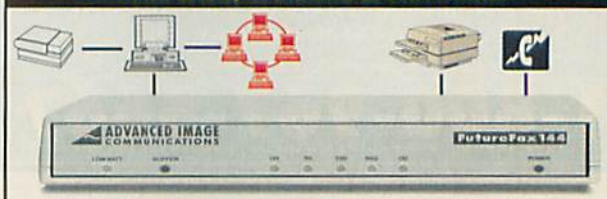

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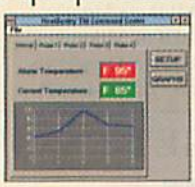

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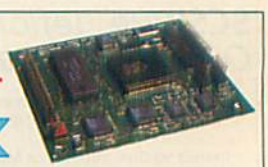

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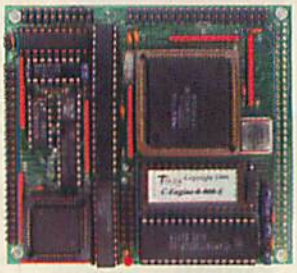

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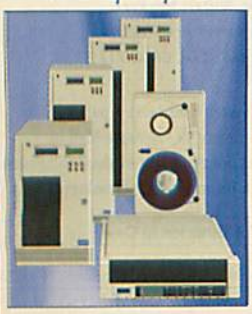

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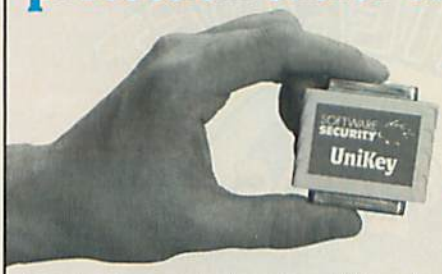

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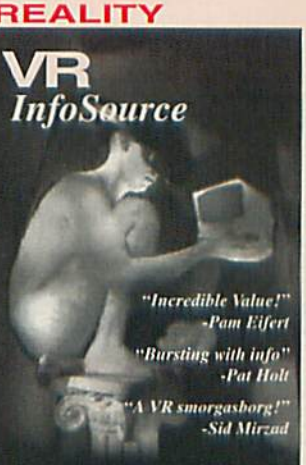

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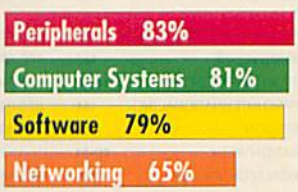

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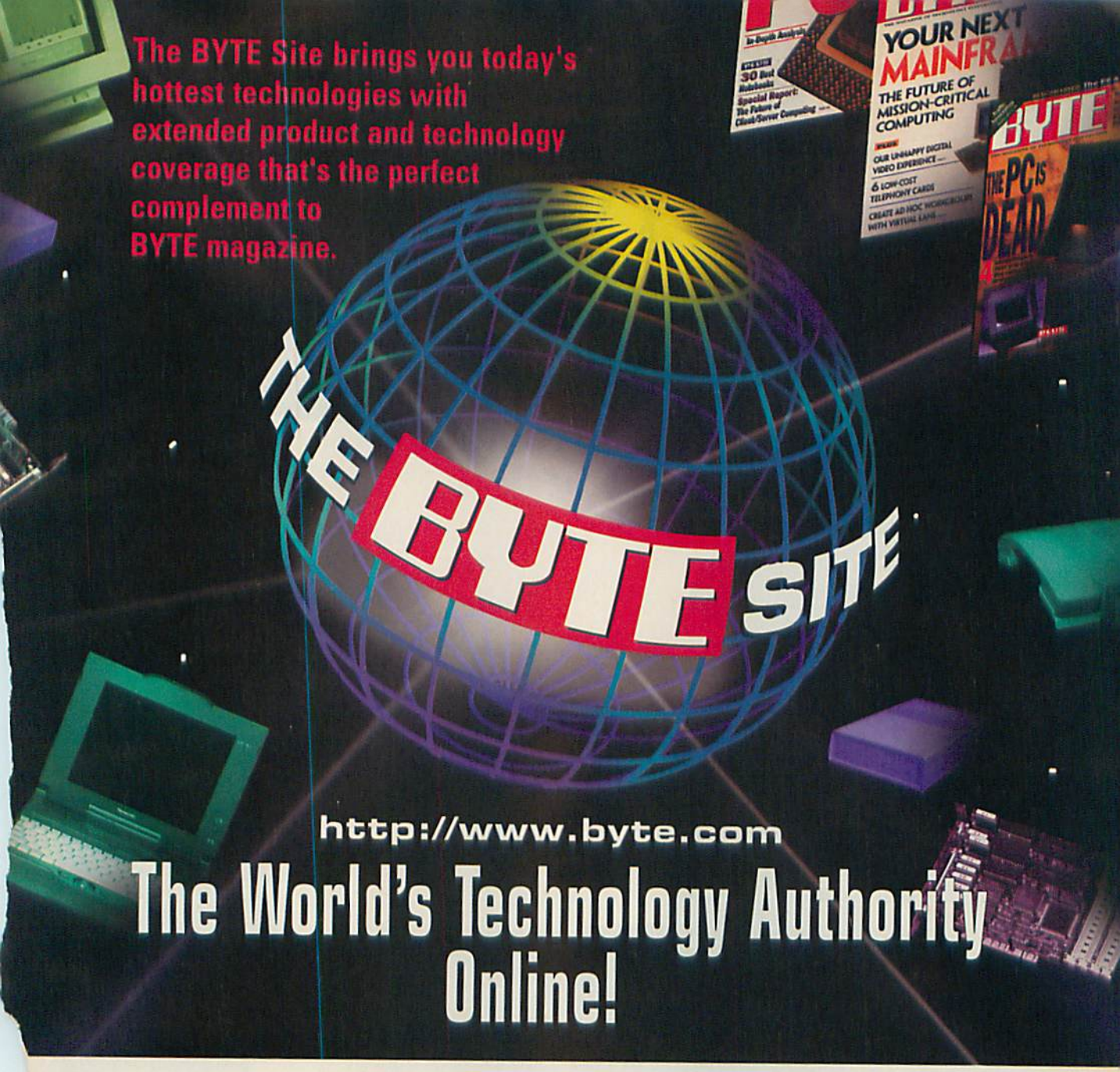

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